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GLASGOW CATHEDRAL

VIEW FROM THE SOUTH.

THE DOUBLE CHOIR
OF
GLASGOW CATHEDRAL:

A STUDY OF RIB VAULTING.

BY
THOMAS LENNOX WATSON.

Fellow of the Royal Institute of British Architects.



GLASGOW :
JAMES HEDDERWICK & SONS.

1901.

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P R E F A C E .

THERE is little documentary evidence bearing upon the Cathedral of Glasgow. For the most part the records of the See have perished, and no more has come down to us than a few incidents of its history, the names of the Bishops and Archbishops, and a number of dates, some of which have been consistently misapplied by those who have written on the subject. The only continuous chronicle of the building is to be found in the building itself, but to make this available a certain measure of acquaintance with the architecture to which it belongs is requisite. The fact may justify an examination of the distinctive features and a statement of some of the problems of the structure from the point of view of an architect.

Had it been possible, I should willingly have dispensed with that portion of the work which follows the history or traces the tendency of vaulting during the period of the construction of the Choir. The story of the building, however, can be read only in the light of its architecture, and this again is inseparably bound up with the progress of the art of rib vaulting. While the references to this wide and intricate subject are necessarily of a somewhat summary character, it is hoped that they may be of service to those who, without special knowledge of vaulting, are yet interested in the architecture of the Middle Ages or in the history of the Cathedral of Glasgow.

It remains only to acknowledge the assistance that has been received in the preparation of the present volume, and in particular to express my indebtedness to the following gentlemen :—

Mr. George S. Hill, A.R.I.B.A., for the use of his series of drawings of the Lower Church, two of which have been reproduced in Fig. 4.

Mr. John James Joass, A.R.I.B.A., for the drawings of the vaulting illustrated in Figs. 30 and 42.

Mr. Alexander MacGibbon, A.R.I.B.A., for the drawings Figs. 16, 21, 27, 32, and 37.

Mr. A. Lindsay Miller, for the photographs reproduced in Figs. 29, 31, and 44.

Mr. James R. King, for the other photographs, 31 in number, taken for the most part by means of the flash light.

Mr. W. W. Robertson, Surveyor in Scotland to H.M. Board of Works; Mr. William Kennedy, his Clerk of Works; and the officers in immediate charge of the building, for the facilities and assistance which they have accorded me.

The drawings Figs. 8, 34, and 45, and the tail-pieces throughout the volume, are from the sketch-book of Vilars de Honecort, a French architect of the period during which the Choir of our Cathedral was erected. The figure on the title-page represents the seal of Bishop Bondington, 1233-1258, under whom the greater part of the Choir was erected.

Most of the diagrams and sketches of the volume, other than those already referred to, have been prepared or completed under my direction by my assistant, Mr. Alexander Millar.

I have also to express my thanks to Mr. Alexander MacGibbon, A.R.I.B.A., and one or two other friends for their perusal of the proofs of the work, and the remarks and suggestions with which they have favoured me.

T. L. W.

GLASGOW, *May*, 1901.

THE DOUBLE CHOIR
OF
GLASGOW CATHEDRAL:
A STUDY OF RIB VAULTING.

*“ There is an art which . . . shares
With great creating Nature.”*

“A Winter's Tale,” Act iv., Scene 3.

THE DOUBLE CHOIR OF GLASGOW CATHEDRAL.

Introduction.

ON the occasion of a visit to the Cathedral, sixteen or eighteen years ago, the writer noticed that the vaulting of the crypt or lower church was of several dates. Up till that time it had been supposed that the whole of the lower vaulting, with the exception of a small portion at the south-west corner, was of one period and constituted one design. It was found that it was, on the contrary, of a variety of date; that in particular the rich vaulting of the middle area was about twenty years later than the vaulting of the adjoining north and south aisles, while that of the eastern aisle and chapels was considerably later than either. Altogether, and including the upper and lower vaulting of the choir, no fewer than five distinct periods may be traced, each separated from the others by an appreciable interval of time. Each succeeding stage of the vault is marked by features characteristic of its own period, and is distinguished from the preceding stage by the introduction of a new and later type of moulding in the vaulting ribs.

In the case of the middle vault of the lower church not only the details of the work but the whole design is of a later period than that of the adjoining aisles, and the observation of this fact leads to the necessary inference that the design, as we now find it, is not the original one, but that it superseded another and radically

different plan of the period of the aisles. To those who are unacquainted with the subject of vaulting this may require a word of explanation.

In designing a vaulted building the arrangement or general plan of the vault is almost the first thing to be determined, as it controls the whole conception of the structure down even to its minuter details. It follows that when the walls and main pillars of the lower church were built there must have been a plan of the whole vaulting of the choir—of the middle compartment as well as of the upper and lower aisles and eastern chapels. Some portions of this early plan were carried out at the time of its inception or soon afterwards, while others were delayed for longer or shorter periods, the original design of such portions, however, being unaltered except as to details. But the vaulting of the middle compartment as we see it is wholly the design of a later period; it represents a stage in the development of the art of vaulting that had not been reached at the period when the aisle vaulting was constructed. It is therefore a later design substituted for the original one.

So far one may go without looking a second time at the vaulting. Having recognised that the original plan of the whole vault, which has been carried out in the aisles, has been superseded by a later design in the middle compartment, one naturally turns to the points of junction of the earlier and later designs, not indeed for confirmation of a fact which is already evident, but with a view to discover the nature of the change and the method upon which it has been given effect to; perhaps also to inquire whether there is any clue to the original purpose of the designer with regard to the middle vault. Obviously the points of junction of the two plans are to be found at the margin of the middle vault—on the inner side of the pillars which divide it from the aisles on the north, south and east, and at the wall which forms its western boundary. The outer springers of the middle compartment were constructed originally at the period of the aisles, and, of course, in accordance

with the early plan. But they are part of the middle vault, which, as we have seen, has been carried out to a later design. They must, therefore, offer some indication of the change from the earlier to the later design.

Those who are sufficiently conversant with the subject to recognise that the superseded plan of the middle vault must have been quite unlike the later plan, will conclude also that the original outer springers, or a considerable proportion of them, must have been replaced by new ones, or, if retained, that they must have been altered to adapt them to the new design. A brief examination of the vault will satisfy us that this is the case. About one-half of the old springers have been removed and new ones substituted for them, and of those that have been allowed to remain a considerable number have been greatly altered from their original condition. The later design has required fewer vaulting ribs than the earlier one, and we find that superfluous ribs have been hewn off and their places left vacant on the springers. Ribs that were unsuitable have been removed wholly or in part and new pieces or new ribs inserted in their place. Where the old springers have been removed bodily and replaced by new ones these have been wrought, in the majority of cases, with mouldings of the later date, while the original springers retain their early mouldings. Many of the ribs which rise from springers of the earlier period have been altered from their original direction—they have been deflected or diverted into the new direction which they were required to take by the later plan—and this deflection takes place just at the level of the upper bed of the springer—at the point, that is, at which the later portion of the rib is joined to the earlier; it will be seen that, on the evidence of the springers as well as on a comparison of the dates of the aisle and middle vaulting, the change of plan has been of a radical character.

The fact is sufficiently obvious and probably it would not have escaped notice so long but for one circumstance—the lower church

is dimly lighted, and the altered springers and twisted ribs are at the darkest part of the interior, at the inner side of the pillars of the main arcade. The builders could hardly have ventured to carry out the work as some of it has been done, had they not counted upon the darkness that in some measure conceals the process by which the change of plan has been effected. This darkness has been intensified within the last fifty years by the introduction of stained glass in the windows, but even with all the daylight that could have been admitted, the inner side of many of the main pillars, in the absence of artificial lighting, must always have been in deep shadow.

Within a few years of the time when these facts came under my observation, the Glasgow Architectural Association, a Society largely composed of architectural students, projected a monograph of the Cathedral.* It happened at this time that I was invited to deliver one of the usual course of lectures of the Association, and, in view of the enterprise on which its members were about to embark, chose the subject of the lower vaulting of the Cathedral. In this lecture, delivered in 1886, an analysis of the vaulting was given corresponding with that of the present work, the succession of the vaulting periods, with the distribution of the mouldings, was illustrated by means of the coloured diagrams now reproduced, and the changes of design and detail as the work proceeded were pointed out.

The lecture was designed, in view of the task to which the members had addressed themselves, to direct attention to certain points of interest in the vaulting which they would have the opportunity of examining more particularly for themselves. The scope of the paper was architectural rather than historical; it involved, however,

* It is to be regretted that this purpose should have been allowed to lapse after considerable progress had been made, and a hope may be expressed for its resumption by a later generation of members. It should be added that we are indebted to the project for the most accurate and beautiful measured drawings that have yet been made of the building, several of which, by the kindness of their authors, I have been permitted to use in illustration of the present volume.

some application of archæological methods, and, in the result, added something to our knowledge of the building. It unravelled the tangled skein of the lower vaulting, and determined the sequence and approximate dates of the several parts of which it is composed; it discovered the change of plan of the middle area and developed the history of the structure during the 13th century; it should be said rather that it permitted the architecture to tell its own story, which it does with a clearness and point that are not surpassed by any building within my knowledge.

The purpose of the address having been served, the further prosecution of the subject was left in the hands of the Association, and the paper was never printed. Its conclusions, however, found their way into the works of subsequent writers on the architecture of the Cathedral, and became in due course part of the accepted history of the building.

In 1895, nine years after the date of the lecture to the Architectural Association, it fell to me to address a meeting of the Architectural Section of the Philosophical Society of Glasgow, and, a desire having been expressed by several of the members that the lecture of 1886 should be repeated, I turned once more to the Cathedral vaulting. As only a small proportion of the members of this Society are architects, it was necessary to recast the paper in more popular form. It occurred to me at this time that it would add to the interest of the subject to show, along with the other diagrams and illustrations, a sketch of the superseded plan of the middle vault, founded on such of the original outer springers as remain and still indicate the direction which the ribs were intended to take. As only a few of these springers have been left as they were first designed, the greater part having been altered or altogether removed, the recovery of the early plan is a work of greater difficulty than at first appears. Further consideration of the subject has led to some modification of my first conjectural sketch. In the present work, I have revised and endeavoured to complete the restoration of the original design of the

middle vaulting, with what measure of success my readers must determine. While the problem is one of some intricacy it has not been without attraction, and the resulting plan, should its general accuracy be admitted, is one of much interest.

An abstract of the paper of 1895 was printed in the Transactions of the Philosophical Society for 1895-1896, and the accompanying illustrations include my first essay towards the recovery of the original plan of the vault, the sketch shown also in Fig. 55 of the present volume.*

To any one versed in Gothic architecture who may glance at the illustrations of the present volume it may seem remarkable that the variety of date of the several sections of the vaulting should have remained unnoticed until a few years ago—that in particular the change of style and difference of date of the vaulting of the aisles and middle compartment should have so long escaped observation. As has been mentioned, the defect of light in the lower church must be taken into consideration, though this will scarcely excuse the oversight on the part of any student of its architecture. More remarkable, however, than any mere oversight is the fact that, after the distinctive styles of the several sections of the vault have been pointed out, their mouldings classified, and the relative dates determined, we should still be met with the statement that the vaulting is of one date, and that the middle compartment has never been designed to be other than it is. Singular as it may appear, such opinions have been expressed and have found their way into two important works recently published. I refer to “The Ecclesiastical Architecture of Scotland,” by Messrs. MacGibbon & Ross, † and the chapter on

* In December 1897, I read a paper on the subject of the vaulting at a meeting of the Glasgow Archæological Society, and its publication in a forthcoming volume of the Transactions has been intimated by the Hon. Secretaries. In the following month I had the pleasure of conducting an excursion party of members of the Edinburgh Architectural Association over the building and illustrating the subject by reference to the vaulting itself. By the courtesy of Mr. Kennedy, Clerk of Works to Mr. Robertson, H.M. Commissioner of Works, the lower church was fully lighted for the occasion.

† Edinburgh, David Douglas, 1896, 1897.

"The Cathedral Church" by Mr. John Honeyman, R.S.A., in "The Book of Glasgow Cathedral," edited by Mr. George Eyre-Todd.*

In the second volume, published in 1896, of Messrs. MacGibbon & Ross's valuable work, my views on the subject of the vaulting were referred to with approval. I was surprised, therefore, to read in the preface to the third and concluding volume, issued in 1897—"Reference is made in Vol. II., p. 172, to Mr. T. L. Watson's theory regarding the vaulting of the lower church in St. Mungo's Cathedral, Glasgow. Having recently had the privilege . . . of attending a meeting on the spot, when the usually obscure edifice was well lit up, and when it was shown . . . that the points on which Mr. Watson based his theory were untenable, we see no reason to believe that the beautiful design of the vaulting and the plan of the shrine were ever intended to be carried out in a mode different from that in which they are executed."

In Mr. Honeyman's interesting essay above referred to it is said—"There can be no doubt that the whole vaulting of the lower church—the arrangement of which is shown on our plan—formed part of the architect's original design, but whether actually executed before or after the completion of the choir, it is impossible now to determine."†

The sequence of the several stages of the vaulting and the fact of a change of design in the middle compartment are not within the range of intelligent controversy, and it is to be regretted that the accomplished, and usually accurate, writers whose works have been quoted, should have allowed themselves to be misled with regard to an obvious and elementary point of architectural history. It is significant that neither of the authors should have referred to the

* Glasgow, Morison Brothers, 1898.

† In the third Rhind lecture of the course of 1900, delivered in Edinburgh on 2nd March, Mr. Thomas Ross is reported to have said—"Probably the original plan was the plan they saw to-day."—*The Builder*, 31st March, 1900.

particular character or date of any part of the vaulting, or to the difference of style and variety of detail with which it has been carried out, while, of course, the altered springers and distorted ribs have been equally ignored. On what evidence their opinion is based these gentlemen do not inform us, and it must be assumed that they have written without due consideration of the subject.*

The argument of the earlier portion of the present work—the sequence of the vaulting periods and the change of plan—will be patent to anyone who is at all conversant with the architecture of the period. Had the purpose of the writer been merely to establish these points the task would have been a short and easy one; the subject of the vaulting, however, is of wider interest and worthy of more extended consideration. As a double, vaulted church of the 13th century, with clerestory and aisles, the choir of Glasgow Cathedral is unique in this country—in many respects it has no parallel anywhere. Its design is such as to involve constructive difficulties in resolving which the builders were without direct precedent,† and the story of the choir vaulting shows by what means these obstacles have been overcome. Its examination discovers to us,

* It is right to add that since the publication of "The Book of Glasgow Cathedral" Mr. Honeyman's opinion has been somewhat modified. In a letter of date 21st January, 1899, which I am permitted to quote, Mr. Honeyman writes:—"I think that the changes in the mouldings of the lower church, which you referred to in your paper read before the Glasgow Archæological Society in December 1897, did not necessarily prove that any great lapse of time occurred between the vaulting of the side aisles and the vaulting of the central portion of the lower church, but in my opinion it was sufficient to prove your contention that these vaults were not of the same age, and to that extent I am inclined to modify the view expressed by me on that point in 'The Book of Glasgow Cathedral,' p. 250, which I may say was in the press long before I had the pleasure of hearing your address. On the other hand, I adhere to my opinion that the arrangement of the piers and the plan of the vaulting is executed as originally designed." Mr. Honeyman does not appreciate the fact that my position is determined as much by the general design of the vault as by the mouldings, or he does not admit that a difference of date is shown as conclusively by the one as by the other. One is glad, however, that he should have dissociated himself at least from the opinion of those who attribute the variety of the rib mouldings to the "exuberance of fancy" of the designer.

† The eastern part of Old St. Paul's, London, with the Church of St. Faith beneath, a few years later in date than Glasgow, is perhaps the nearest analogue.

in the continuous modification of detail in succeeding stages of the work, something of the process followed by the mediæval builder, while the complete change of design in the middle vault, following upon an interval of only twenty years, illustrates once more the rapid development of the style, and shows on the part of the designer, whether the change was due to his own initiative or to that of others, a sustained effort to improve and perfect his art.

In referring to this part of the vault as "a pretty and instructive puzzle," Sir Gilbert Scott has described it better than he knew. To the solution of this puzzle as we now understand it, with the recovery of the superseded plan, the concluding chapters of the volume have been devoted. With a view to enlist the co-operation of the reader the points which bear directly on its disentanglement have been illustrated with some fulness by means of photography and measured sketches. It is hoped that the result may be to confirm the restoration of the early plan herein contained, or to supplement and amend it wherever it may be doubtful or erroneous.

While the inquiry has been directed to the double choir of the Cathedral, with its successive stages of vaulting, it has led to some revision of the chronology of other parts of the building. Part of the lower walls of the nave and transepts, as well as one section of the under-building of the choir, are here attributed to the 13th, instead of the latter part of the 12th century, and ascribed to the bishopric of Walter, in place of that of Jocelin; an explanation is offered of the fact that one compartment of the lower church should have been completed before the rest of the choir building was begun, and the presence of a fragment of a still older structure incorporated with this part of the work, the subject of much fruitless controversy, is accounted for, as I think, not unreasonably. These excursions may be described as incidental to the examination of the choir vaulting, and thus fall within the scope of the present work.

Chapter I.

Historical Notes.

WHILE the building of cathedrals was carried on during nearly the whole era of the Middle Ages, there is one short period which may be particularly described as the age of the cathedral. An eminent writer * has informed us that all the great cathedrals of central France were begun, and to a large extent carried out, between the years 1180 and 1240, a brief period of 60 years. Previous to 1180 the cathedrals, with few exceptions, were of moderate size, being exceeded in this respect by the more important of the abbey churches. The sudden enlargement of the cathedral towards the close of the 12th century coincides with the development in power, wealth, and intelligence of free urban communities, and marks the decline of the feudal and monastic systems. The rapidly expanding towns were seized with a passion for the erection of these great churches, and within a few years France, and indeed a great part of Europe, was covered with edifices that still excite our wonder. Such was the intensity of the impulse to rebuild and enlarge the cathedrals, and such at this time was the rapidity of the development of architectural style, that portions of a building were in many cases pulled down within a few years of their erection, to make way for larger and more magnificent projects.

After the middle of the 13th century the enthusiasm for cathedral building relaxes almost as suddenly as it had begun. From this time no more large cathedrals are founded, nor are great sums of money collected within a short period for their construction; the

* Viollet-le-Duc, "Dictionnaire raisonné de l'Architecture."—Article "Cathédrale."

work goes on, it is true, but slowly as compared with its former rate of progress. To some extent the cathedral loses its hold on the popular imagination, and becomes more exclusively the province of the ecclesiastic. The change is reflected in the altered arrangement of the interior, the multiplication of chapels, and the erection of screens and enclosures within the building.

The beginning of the period of activity in this country was signalised by the rebuilding of the choir of Canterbury Cathedral, destroyed by fire in 1174, and we find that at this time there existed in England, as well as in other parts of Europe, a school of lay architects and craftsmen. In describing what took place after the fire at Canterbury, Gervase informs us that French and English artificers were summoned, among others William of Sens, a "man active and ready, and as a workman most skilful both in wood and stone. Him, therefore, they retained, on account of his lively genius and good reputation, and dismissed the others."* Four years later the French master was disabled by an accident, "and another succeeded him in the charge of the works ; William by name, English by nation, small in body, but in workmanship of many kinds acute and honest."†

There was already in existence, therefore, previous to 1174, the nucleus of the great school of architects, sculptors, and builders who, during the later years of the 12th and the first half of the 13th century, reared so many noble cathedral and other churches. Allowing for its development during the earlier years of the 12th century, it is still remarkable that so large a body of highly skilled artists and artificers could have been brought into existence at this time. We can imagine bands of workmen travelling from place to place, and we know that the architects, at all events, took long journeys, but it must be remembered that the building of large

* Professor Willis' translation, "Canterbury Cathedral," p. 35. Longman & Co., London, 1845.

† *Ibid.*, p. 51.

churches was carried on simultaneously over a great part of Europe. When we think of the amount of this work, its wide distribution, and uniformly high quality, it must remain one of the wonders of history how such a number of designers and craftsmen could have been produced, and reached such level of attainment, as the builders of the 13th century.

During the period of great activity in the founding and building of cathedrals, the church of Glasgow appears to have been three times planned anew on a scale of ever increasing size and elaboration. Jocelin, Walter, and Bondington were the bishops responsible for the several projects, and it is with their work, and particularly with that of the last-named, that we are concerned in the following pages.

Before entering upon an examination of the vaulting, it is necessary that a few outstanding facts connected with the building should be mentioned. We do not attempt even the briefest history of the See or of the building, but desire to refer only to some of the incidents of closest bearing upon the architecture which we are about to describe.

The See of Glasgow is said to have been founded by St. Kentigern or Mungo, who died in the beginning of the 7th century. In the famous "Notitia of David," a document of the early part of the 12th century,* Kentigern is described as having been the first bishop of Glasgow, and we are informed that subsequently to his time, through the wiles of the evil one, the country relapsed into heathenism, and continued in this state till the restoration of the church by David, Prince of Cumbria and afterwards King of Scotland. David appointed his chaplain and chancellor, Achaius, to the restored See in 1115. The first church of any structural importance on the site was begun about 1123, and consecrated in 1136. About 40 years later it was destroyed by fire.

As Achaius was absent from his charge from 1125 till 1138,

* See translation by Mr. J. T. T. Brown. "Scots Lore," vol. 1, page 36. 1895.

he could not have had much to do with the building personally. It is, however, convenient to refer to it by his name. No trace of this building remains to our day, and we can only form a general idea of its character from contemporary work.

The church of Achaius must have been of comparatively small dimensions, with thick walls and massive pillars, and the probability is that it was covered by a wooden roof, and unvaulted with the exception of the crypt. The arches must have been semi-circular in form, and such sculpture as it possessed would be of the kind found in Norman buildings, produced by means of a small pointed axe or hammer—rude and primitive indeed, but not without vigour and beauty.

At the time of Achaius the crypt, as an adjunct to the cathedral, was already obsolete, or rapidly becoming so, owing to the growing custom of bestowing the relics of the saints within the choir itself instead of in a vaulted chamber beneath it. Professor Willis has pointed out* that all the English eastern crypts were founded before 1085, though some of them, as Canterbury and Rochester, were extended at a later period.† It may be assumed, however, that the church of Achaius possessed a crypt, or lower church,‡ at the eastern end, for the same reason that we find this feature in the buildings that succeeded it; the site on which the Cathedral is built slopes down in an easterly direction, and, as in Bourges Cathedral in France, and several others in Germany and Italy, an under-building is necessary to raise the choir to a suitable level. The crypt of Achaius would naturally be covered with the plain and heavy vaulting of the period carried on closely-set pillars.

* "Canterbury Cathedral," p. 71.

† The 13th century crypt or undercroft of the Lady Chapel at Hereford is exceptional.

‡ In old documents the term usually employed was *bassa ecclesia* or *inferior ecclesia*. See Preface to "Registrum Episcopatus Glasguensis," page xxxiv., and "The Book of Glasgow Cathedral," p. 317.

At this time the choirs had begun to extend themselves eastwards, and the semi-circular apses of an earlier period had been abandoned. The change from the semi-circular apse to the square eastern termination seems to have taken place in England about the close of the 11th century. The cathedral church of Old Sarum, dedicated in 1092, had the east end square—not apsidal. The case of Ely Cathedral is still more interesting and definitive. Its Norman eastern termination was pulled down when the existing presbytery of the 13th century was erected, but an examination of the sub-structure by Professor Willis* showed that the Norman foundation, originally disposed for a circular apse, had been modified to enable it to carry a square termination. The Ely Chronicle records that the foundation was laid by Abbot Simeon about 1082, and that the work was then suspended. Operations were resumed by Abbot Richard, and the building, of which Simeon had constructed the foundation twenty years before, was erected between 1100 and 1107. The change from round to square must therefore be attributed to Richard, and the incident points to the abandonment of the circular apsidal termination in England as having taken place at the close of the 11th century.†

When the crypt fell into disuse it became necessary to enlarge the choir to provide for an increasing number of the tombs and reliquaries of the saints, as well as to admit of a more elaborate ritual and a larger number of ecclesiastics. Very early in the 12th century we accordingly find this movement already in progress. Before the year 1107 Anselm and Ernulf pulled down the choir of Lanfranc at Canterbury, within twenty or thirty years of its completion,

* "Vilars de Honecort," page 82. London, 1859.

† The choir of the two Williams at Canterbury, 1175 to 1185, may be regarded as an exception, but this was the design of a Frenchman, and was modelled upon a French cathedral—that of Sens. It may be added that it is not the choir proper, but the Chapel of the Trinity that has a circular eastern termination. The church of Lanfranc, 1070 to 1077, was apsidal, and the choir of Ernulf and Conrad, given by Willis as *c.* 1098 to 1110, had a fully-developed circular east end, as its crypt still shows. Besides Canterbury there are a few apsidal terminations of the 12th century.

in order to the erection of a more extended choir, and from this time the tendency towards the enlargement of the choir became general. We must not, therefore, fall into the error of assuming that the church of Achaius, still less that of Jocelin, had no more than the short choir with apsidal termination characteristic of the churches of the 11th century. As the church of Achaius was not begun till 1123, the probability is that its east end was square and not apsidal, while at the time of Jocelin the semi-circular apse was long out of date. Both of these buildings fall within the period of enlarging choirs, and the later one even approaches the time when they attained their greatest development.

We have seen that the building of Achaius was destroyed by fire forty years after its consecration. It is remarkable how often we read of this fate having overtaken the churches of the 11th and 12th centuries, some of them having been burnt down twice or even three times within that period. The desire to protect the sacred buildings and their contents from this enemy was a strong incentive to the development of stone vaulting, and it was thus an important factor in the evolution of Gothic architecture, a style in which nearly every feature may be traced to its origin in the vaulting system.

We do not know the extent of the disaster which at this time befel the church at Glasgow, but it may be assumed that what was spared by the flames was afterwards pulled down to make way for a new and larger building, the church of Jocelin. With Jocelin's appointment to the See (1175) we approach the period of greatest activity in cathedral building, as well as of enlarged structures and extended choirs—the period which within the lifetime of one man saw the successive buildings of Jocelin, Walter, and Bondington rise from the ground.

As with many of the secular foundations of this time, the church and burgh of Glasgow were closely associated, and even, in great measure, mutually dependent on one another. The civil and

religious aspirations of the people alike found expression in the Cathedral, which was their town hall and court of justice as well as their church. Multitudes were attracted to the place to worship at the shrine of the saint, and the increasing burgh flourished already "by the preaching of the Word." There are many indications of the simultaneous development of the town and church thus intimately related to one another. A charter was obtained from William the Lion between the years 1175 and 1178, conferring the freedoms and customs of a King's burgh and the right to hold a weekly market.* Ten years later the right of an annual fair of eight days was obtained, while large accessions of property throughout the kingdom were secured to the See. The wave of popular enthusiasm had risen; the time was ripe for founding a city and building a Cathedral—it may be said that even the fire was opportune.

We have come now to the epoch of the cathedral, the period of sixty years, from 1180 to 1240, referred to by Viollet-le-Duc. If we extend this period so as to include the whole episcopates of Jocelin and Bondington, we have a span of 83 years, from 1175 till 1258, during which the church was governed by six bishops. Three of these may be left out of account so far as the building is concerned. These are Hugh, who died two months after his election in 1199; Malvoisin, elected also in 1199, and translated to St. Andrews three years later; and Florence, 1202 to 1207, who was elected but not consecrated.† We are thus left with three illustrious bishops, builders of the Cathedral, each of whose terms extended to nearly quarter of a century—Jocelin, 1175 to 1199; Walter, 1208 to 1232; and Bondington, 1233 to 1258.

Fifty years ago the whole main structure of the choir was absurdly ascribed to Bishop Jocelin so far as it was not attributed to still earlier prelates. We have now done justice to Bondington's

* "Registrum Episcopatus Glasguensis."

† *Ibid.*

important part in the building,* but it is curious that Bishop Walter's name should still be ignored, and that everything older than Bondington's time should be attributed to Jocelin or to his predecessors. As we have pointed out elsewhere,† it is clear that Walter was one of the builders of the Cathedral. He succeeded to the still unfinished work of Jocelin, and occupied the bishop's chair for twenty-four years in the very middle of the period of greatest activity in cathedral building. There is record further of the renewal or confirmation to Walter of the charter that had been granted to Jocelin of a fair for the purpose of raising funds for the building. He must, therefore, have been actively engaged in the work, and we cannot avoid asking what part of the building is his. It is inconceivable that Walter's work should have been destroyed while that of Jocelin was preserved, but it is quite in accordance with probability that Jocelin's work should have been pulled down by Walter to make way for his own. Lastly, we submit that the greater part of the work now attributed to Jocelin is not of his period at all, but of that of Walter. In view of the facts, it is scarcely reasonable that the claim of Walter should have been consistently ignored and his work attributed to earlier bishops or passed over without notice. In one of the latest and most interesting accounts of the building‡ his name is not mentioned, while a long argument is introduced to show that the design of the nave is due to Jocelin. But, what of the interval between Jocelin and Bondington, a period that must have been one of strenuous effort in the building, and what evidence of 12th century work or design is to be found in the nave? The church of Jocelin, so far as it was carried out, must, we

* The error was pointed out in a pamphlet, "The Age of Glasgow Cathedral," by Mr. John Honeyman, Glasgow, 1854.

† Transactions, Philosophical Society of Glasgow, 1895-1896.

‡ By Mr. John Honeyman, R.S.A., in "The Book of Glasgow Cathedral," Glasgow, 1898.

think, have been pulled down by Walter, and only a few fragments connected with the existing structure can be identified as the work of the 12th century.

From its date at the beginning of the period of great cathedrals, as well as from the fragments that remain, we conclude that Jocelin's church was to have been a large and important structure. As a portion of it was dedicated only two years before his death, it is evident that it was never completed. Walter must have succeeded, therefore, to an unfinished building that had been founded about 30 years before his time. During the nine years that elapsed between Jocelin's death and Walter's appointment to the See the work was probably in abeyance, and on his election Walter would be faced with the alternative of continuing and completing Jocelin's work or of rebuilding the church on a new plan. A bishop of the 13th century, on the threshold of a new architectural era, would be unwilling to carry on a building of an obsolete and superseded style. He must, we think, have decided to rebuild, and Jocelin's unfinished church, like so many others of the 12th century, would have to make way for a building in the new style of architecture then on the point of achievement.

Such, at all events, is our interpretation, in opposition to that of former writers, who attribute much of the existing structure to Jocelin's episcopate and nothing, at least of the design, to that of Walter. The work that can be recognised as Jocelin's is, we think, confined to a small section of the building, and consists of fragments merely of his church, and these, as we shall see afterwards, not *in situ*. Though of small extent, they are nevertheless enough to show that the church was projected on a large scale, and that its style was full and elaborate for the period to which it belonged. Evidently it was to have been an important structure, perhaps not greatly inferior in size to those which succeeded it. The choir, which we conclude to have been the portion carried out either wholly or in part, must have been a large one, with vaulted crypt, and probably also

with vaulted aisles, and having a square eastern termination.* As we have said, fragments of the structure may still be seen, some of them incorporated with the later work, from which an architectural Cuvier might reconstruct the building, but we do not think that any work of the 12th century, either of the later or the earlier church, can be pointed to, that is still *in situ*, if by that we mean occupying its original position in the building. We return to the point in the following chapter.

The lower wall of the nave and transepts, with the south-west compartment of the crypt, is attributed to Jocelin, but without evidence, and, as we think, erroneously. The details point to the early years of the 13th century as the date of this part of the work, and as Walter was actively engaged on the building during his term from 1208 to 1232, we may conclude that the work is of his episcopate. He appears to have projected nothing less than the erection of a new Cathedral, and, more ambitious perhaps than prudent, to have begun the construction of the nave and choir simultaneously. We have, at all events, the south-western portion of the crypt and the lower walls of the rudimentary transepts and of the nave, all apparently of one date and of Walter's period. The wall shafts of this part of the crypt and those of the nave are of the same character, and the wall base outside, beginning in the middle of the broad buttress that marks the junction of Bondington's work with that of Walter, is carried across the south transept and round the nave. It is thus difficult to resist the conclusion that they are of one date, and show this part of the choir building and the lower walls of the nave in course of simultaneous construction.

Almost the first step to be taken by Walter towards the erection of his new Cathedral must have been the demolition of the south-

* The circular apse was out of date at this time by nearly a hundred years. The east end of the period is almost invariably square, but a curious exception may be found in the work of St. Hugh of Lincoln, whose choir had a semi-hexagonal termination.

west corner of Jocelin's choir, followed by the construction of this, the earliest part of the new crypt, with its appointment as a temporary chapel. This chapel, designed as part of the south aisle of the crypt, is more particularly described in the next chapter.

We have seen that Walter followed Jocelin after an interval of nine years, and that he began by pulling down the unfinished church that had been founded by Jocelin about thirty years before. Bondington succeeded Walter in 1233, when the art of the 13th century was approaching its full development. More conservative than Walter, or realising more fully the magnitude of the task that lay before him, he decided to continue the work that Walter had begun; he concentrated his efforts on the eastern half of the building, leaving the nave walls in the unfinished condition in which he had found them; by thus limiting his operations he was enabled, within the twenty-five years of his episcopate, to carry the choir nearly to a conclusion.

Such was the rapidity of change in architectural style at this time that at Bondington's accession the work that had been begun by Walter was already out of date, and it became necessary to revise the design of the choir. The new design of Bondington, however, was made to accommodate itself to what had been already built, and on this plan, subject to certain modifications at a later date, and to the further development of the style, the work was carried to completion.

As the succeeding chapters are mainly devoted to an examination of Bondington's work, any particular description of his plan may be omitted in this place. Its chief peculiarity is that, as must have been the case with the preceding buildings, it comprises an upper and a lower church. To some extent it was governed by Walter's work, of which it was a continuation, but its architecture reflected the latest phase of development of the art. This was the case not only when it was begun, but, so far as

circumstances permitted, throughout the period of its construction. While its general arrangements, with certain exceptions, remained as they had been planned, the details of its architecture, as was usual in the middle ages, were continuously subject to revision as the work proceeded. This is especially noticeable in the vaulting and in the details of moulding and sculpture, which are such that one may trace the progress of the work from point to point and follow its course of construction from beginning to end with great facility.

The peculiarity of the transepts, which do not project beyond the walls of the aisles, was already settled, and the walls were partly built, in Walter's time. We know nothing with certainty as to the reason for this absence of projection, but the great amount of labour involved in the construction of an elaborate lower church, and the extent of the accommodation thus provided, may well have led to a desire to restrict the work of the transepts as far as possible. The unfinished outer south transept is, of course, later than Bondington's time, and was probably designed to be of no more than the height of the aisles and eastern chapels, in which case it would not have interfered with the gable of the transept proper.

The procession path behind the high altar is common to nearly every variety of cathedral plan after the 11th century. At Glasgow it takes the somewhat unusual form of a double aisle, or an aisle and chapels, beyond the eastern gable of the choir, and vaulted and roofed at the same level as the north and south aisles. The church of St. Saviour, Southwark, where there are three aisles instead of two, is perhaps, among the larger churches, the one that most nearly resembles it at this point.*

In France the semi-circular east end is general throughout the mediæval period, but the earlier and plainer churches of the Cistercian Order are an exception to the rule. At Citeaux itself there was a square east end with a single low eastern aisle.†

* The plan of the east end at Glasgow is reproduced on a small scale at Roslin Chapel.

† Viollet-le-Duc, "Dictionnaire de l'Architecture," Vol. I., p. 271.

A close parallel to the eastern termination of Bondington's choir is found in the sketch-book of Vilars de Honecort, a French architect of the 13th century, the designer, it is believed, of the choir of Cambrai Cathedral in France, destroyed at the time of the Revolution, and of important works in Hungary and elsewhere.* We reproduce this sketch (fig. 8), to which Vilars appends the note :—
 "This is a square church which was designed for the Cistercian Order." †

During Bondington's episcopate renewed efforts were made to raise money, and there is evidence of much activity in the prosecution of the building. In 1241 Alexander II. granted the right of free forest in the lands belonging to the manor of Glasgow, while in the following year an order was obtained from the Provincial Council at Perth that on every Sunday and holiday from Ash Wednesday to Low Sunday the duty of contributing to the work should be enjoined on the people in every parish church throughout the kingdom, and that during this period no other collection should be taken.‡

The choir was carried nearly to completion under Bondington, but that prelate, as he had not begun, so neither did he live to put the finishing touches to the work. The second, third, and

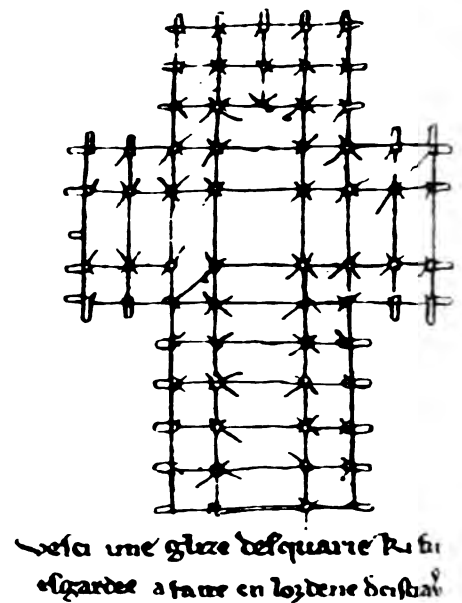


Fig. 8.

Vilars' plan of Cistercian Church.

* This unique and priceless work was found in the library of the Abbey of Saint Germain des Près, and is now preserved in the National Library at Paris. It has been published in fac-simile, with notes and descriptive articles by Professor Willis and Mm. Lassus and Quicherat ; London, T. H. & J. Parker, 1859.

† Vesci une glize desquarie ki fu esgardee a faire en l'ordene d'Cistiaux.

‡ Registrum Episcopatus Glasguensis.

perhaps the fourth stages of the vaulting fall within the quarter of a century during which he held the See, and they offer an illustration of the rapidity with which the art of vaulting, and indeed the whole style of architecture, advanced at this time, the period perhaps of swiftest transition that has been seen.*

After Bondington's death in 1258 several changes took place in the episcopate, till the election, in 1272, of the warlike Robert Wishart, who held the bishopric during the long period of 44 years. After his appointment we read of other parts of the building being in progress, and infer from this, what we learn also from the architecture, that the choir was, at all events, not far from completion. In 1277 the Chapter purchased the privilege of cutting timber at Luss, on Loch Lomond, for building the tower and treasury; while in 1291 Wishart got sixty oaks from Ettrick, which he was accused of converting into engines of war instead of employing them in the building. By this time a great change had come over the relations of Scotland with England. With the death of Alexander III. in 1286 there ended a period which has been called "The golden age of Scottish history." Peace had been maintained with England for nearly a hundred years, and during this time great progress had been made in the social improvement and political advancement of the people of both countries, and in commerce, agriculture, and other industries. This prosperous and peaceful time is of some importance in the history of the Cathedral, and its coincidence with the period of activity in cathedral building in North-Western Europe may be noted. Its earlier years had seen the church of Jocelin under construction, its middle period witnessed Walter's building in progress, and its closing years found the choir of Bondington practically finished, but the structure otherwise incomplete. The death of Alexander III. was followed by a regency, by the contest

* "Pendant les regnes de Phillippe-Auguste et de Saint Louis, les progrès de l'architecture sont si rapides, qu'une période de cinq années y introduit des modifications sensibles."—Viollet-le-Duc, "Dictionnaire de l'Architecture," Vol. II., p. 425.

for the Crown of Scotland, by the struggle for independence and successive wars with England. The bitterness and long duration of hostility between the two countries is commemorated in the architecture of Scotland. Up till the closing years of the 13th century the ecclesiastical buildings are uniform in style with those of England. From this time, however, the architecture of Scotland parts company with that of her more powerful neighbour. Friendly intercourse between the two countries had almost ceased, and during the 14th and 15th centuries their architectural styles have hardly anything in common. Hence it comes that the archæology of Scotland during these two centuries is difficult and sometimes uncertain. During the 13th century, with which we are concerned in the present work, it is fortunately quite otherwise. Here we have the development of architectural style in all its main features identical with that of England. Here accordingly we have the broad basis of English archæology to found upon, and there is little either of difficulty or uncertainty. To the architect, therefore, the succession of periods found in the eastern arm of our Cathedral should be perfectly legible.

The choir of Walter and Bondington was in progress for at least half a century, while the nave must have remained in its unfinished condition for more than a hundred years and the proverb spoke, not without reason, of "St. Mungo's work which will never be finished." We must not suppose, however, that the mediæval builder worked always slowly and painfully or without regard to the time that his task might occupy. On the contrary, where no pecuniary or other difficulty was experienced, nothing is more remarkable than the rapidity with which the buildings of this period were constructed—a rapidity such that it is doubtful whether it could be exceeded appreciably at the present time. Several important churches of the 13th century in France were built within five years; even in the last quarter of the 12th century the choir of Canterbury, with its transepts and chapels, a structure larger

than the whole Cathedral of Glasgow, was erected within ten years, and of this time one year was spent in preliminary work, for one year operations were stopped altogether for want of funds, while in each of the remaining years the work was suspended during the winter months, thus reducing the time actually spent on this large building to about six years. If the labours of an age were sometimes required to compass the erection of a great cathedral it was not usually the builders who were at fault ; more commonly it was owing to the impossibility of raising with sufficient rapidity the large sums of money which the work required. The nominal revenue of the See of Glasgow was considerable, but it was collected with difficulty from the more distant and unsettled parts of the country, while the ordinary expenditure of the church must have engaged a large part of it. The records of the See indicate the efforts, extending over many years, to raise money for the purpose of the building, and it may be assumed that the funds for the work did not come in so rapidly as they were required, and that the delay in the progress of the building was largely due to this cause.

Within the main building of the choir five distinct stages of the vaulting may be found, extending over a period of not less than fifty years. We cannot suppose the work to have been carried on continuously during all that time, and conclude, therefore, that it must have been interrupted from time to time. On the other hand, it is equally clear that there was no prolonged suspension of the work, but rather a series of interruptions. We judge, then, that the delay was mainly due to the difficulty of raising so much money as the building demanded. Either the progress of the work was continuously impeded from this cause, or, what is more probable, the operations were carried on with energy so long as the money which had been collected served. When the treasury was exhausted they were of necessity suspended. We have seen that even the wealth of Canterbury did not suffice to complete

the choir of the two Williams without the interruption of a year, and most of our cathedrals, if not all, must have been delayed in their construction from the same cause. The interesting result at Glasgow has been a series of examples illustrative of the progress of architecture, and in particular of the development of vaulting, during a great part of the 13th century.





Fig. 9.

South-West Compartment, Looking West.

Chapter II.

Bishop Walter's Chapel.

IN considering the problems and difficulties which the cathedral builders were called upon to meet there is one that is sometimes overlooked. These large churches were not only places of assembly and worship—they were at the same time repositories of the relics of the saints. From a very early period of the Christian era it had been the custom to build oratories or chapels over the places of martyrdom or of interment of those who had died for their faith or who had been distinguished otherwise for piety. At a later date it was the practice to bestow the bodies of those who had been eminent in the Church within the sacred edifices, either in a crypt beneath the church or within the choir itself, “to the intent that they might have their resting-place where they had living ruled in honour.”* The cathedral of the middle ages was accordingly something more than a church; it was a great reliquary, a place consecrated by generations of religious service at the tombs of the saints whose relics were regarded with peculiar veneration. When it was required to enlarge or rebuild a cathedral two conditions were imposed on the builders—the daily services of the church had to be maintained, and the tombs and relics of the saints protected against injury or unnecessary disturbance during the operations, frequently prolonged over a long term of years. In the records of several of our cathedrals evidence may be found as to the manner in which these conditions were observed. We have, for example, contemporary accounts of what took place at Canterbury after the fires both of 1067 and of 1174, and during the reconstruction that followed in each case.

After the earlier of those fires, as we are informed by Edmer

* Gervase. Willis, “Canterbury Cathedral,” p. 2.

the Singer, "There was erected over the resting-place of the blessed man (Archbishop Dunstan) a house of small magnitude; and in this were performed daily over his holy body, masses together with the other services."* Three years later, when Lanfranc came to Canterbury, we are told that he first built the necessary offices for the convent, while "As for the church, which the aforesaid fire, combined with its age, had rendered completely unserviceable, he set about to destroy it utterly, and erect a more noble one. And in the space of seven years, he raised this new church from the very foundations, and rendered it nearly perfect. But before the work began, he commanded that the bodies of the saints, which were buried in the eastern part of the church, should be removed to the western part, where the oratory of the blessed Virgin Mary stood. Wherefore, after a three days' fast, the bodies of those most precious priests of the Lord, Dunstan and Elphege, were raised, and in presence of an innumerable multitude, conveyed to their destined place of interment, and there decently buried. To which I, Edmer, can bear witness, for I was then a boy at the school.

"But, in process of time, as the new work of the commenced church proceeded, it became necessary to take down the remainder of the old work, where the bodies of the saints just mentioned were deposited. Having prepared, therefore, the refectory of the brethren for the celebration of the Divine Service, we all proceeded thither from the old church in festal procession, bearing with honour and reverence our glorious and sweet fathers, Dunstan and Elphege.

"When the high Altar of the old church was taken down, the relics of the blessed Wilfrid were found, and placed in a coffer (scrinium); but after some years, the brethren became of opinion that they ought to have a more permanent resting-place, and, accordingly, a sepulchre was prepared for them, on the north side of an

* Willis, "Canterbury Cathedral," p. 13.

altar, in which they were reverently inclosed, on the fourth idus of October. Moreover, when the other altars were destroyed, all the holy places, which the wisdom of the ancient fathers had constructed within them, were discovered; to the truth of which I can bear a faithful testimony, seeing that I was myself an eyewitness of all that was done.

"After a few years, the bodies of the pontiffs, Cuthbert, Bregwin, and their successors, were brought into the newly-founded church, and placed in the north part, upon a vault, each in a separate wooden coffin, and there, daily, the mystery of the Sacrifice of Salvation was celebrated."*

Of the fire of 1174 and the subsequent reconstruction of the choir by William of Sens and William the Englishman, we have a graphic account by Gervase, in which we are informed that the bodies of the saints were again moved into temporary resting-places in the nave, where an altar and station were put together. From this temporary chapel they were finally removed in the sixth year after the fire, and as soon as the new choir was sufficiently advanced to receive them.

Much more might be cited to the same purport, but what has been given may be sufficient to illustrate one phase of cathedral building that must have been of continual recurrence. We have no Edmer or Gervase to tell us what took place when the church of Achaius was burned or that of Jocelin pulled down, but we know that there must have been venerated relics in both of those edifices, as well as in such ruder buildings as may have preceded them. We are told by one of Kentigern's biographers of the 12th century that on his death the saint was buried beneath a stone on the right side of the altar in his church, and we may assume that the tomb, with what were at least believed to be the bones of the saint, was carefully tended in successive buildings on the site. If, then, we have a shrine to be protected during the construction

* Willis, "Canterbury Cathedral," pp. 14-16.

of the buildings, and daily service to be performed at the altar and tomb of the saint, it follows that this must have been a factor in deciding the order and method on which the work was to be carried out, and a key is supplied to one at least of the problems of the structure, the early south-west compartment of the crypt.

This section of the building, situated at the west end of the south aisle, occupies three bays of the lower church, corresponding to one bay and a half of the choir aisle above (fig. 2). The plan is peculiar, the vaulting contracting in width at the west end, where

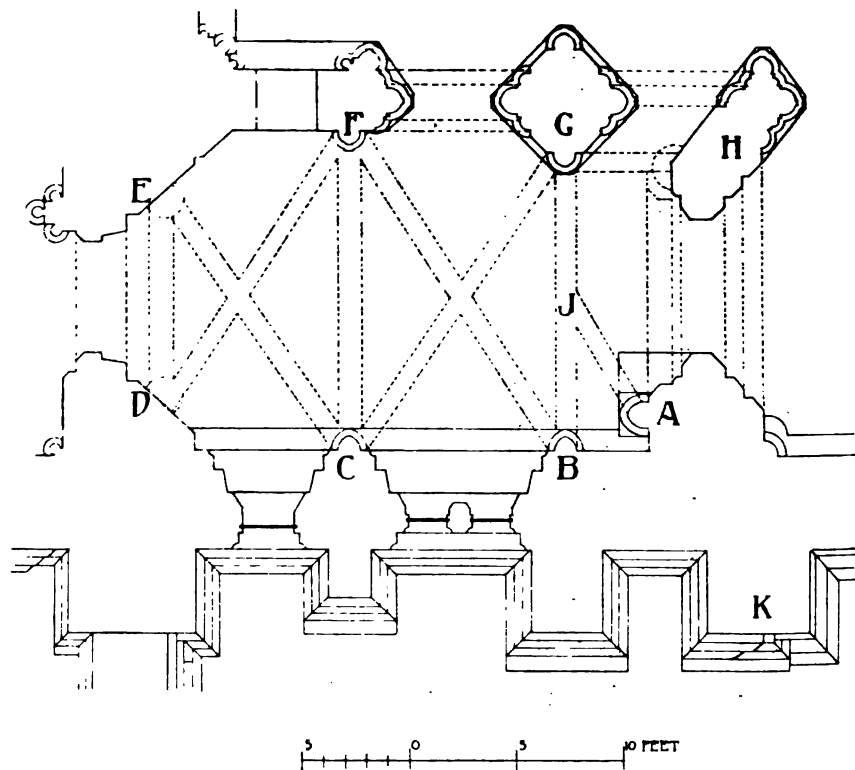


Fig. 10.

Plan of South-West Compartment.

the ribs spring from two moulded corbels, D E (fig. 10), and finishing on the south-east with an eccentric half diagonal A J which springs awkwardly from the capital of a unique shaft A on the east wall of the compartment, and close to its south-east corner.



Fig. 11.
Jocelin's Pillar.

This chamber, of no larger dimensions than a private parlour, is of particular interest, not only as the oldest part of the building, but from the fact that within its narrow limits four periods of architecture meet—the periods of Jocelin, Walter, Bondington (1240), and finally that of the reconstruction of the vault, about 1260. The shaft A (fig. 10) is of Jocelin's time, the shafts B and C and the south wall are of Walter's building, while the pillars F, G, and H are Bondington's. The vaulting is Walter's, but has been reconstructed at a later date, following the original design and employing for the most part the old material. The arch G H, and a portion of the pillar H, are of the period of the reconstruction.

The shaft A has long been looked upon as the sphynx's riddle of the Cathedral, though, as it seems to us, of less difficulty and of no greater interest than many of the other problems of the building. If we essay to guess it, it remains to be seen whether we shall escape the fate which may be supposed to have overtaken those who have preceded us in the attempt.

As shown by the plan (fig. 10) and the photograph (fig. 11), the pillar is peculiar in design, and still more so as to its situation. Like the shafts B and C, and those of the nave walls, its horizontal section is composed of two segments of a circle, forming an edge or arris in front, but it is of different size and proportion from the other edged pillars. It has an early base with square plinth and a disproportionately heavy octagonal capital with rudely carved foliage of early 13th century character.* Its position is still more remarkable. A portion of an east wall is encountered where no east wall was to be expected, and a shaft is found in what may be described as an impossible situation, on the east wall, but close to the angle which it forms with the south wall of the compartment.

Previous writers have ascribed this unique shaft to a great variety of dates, and attributed it to a succession of early bishops, but on one point they are agreed—and on this their

* The carving might, however, be of the closing years of the 12th century.

unanimity is wonderful—that the shaft, with its capital, base, and what is called its bench table, is *in situ*. Much ingenuity has been expended in devising the plan of an earlier building that would explain the pillar, and in showing that its position is such as to support each author's conception of what the earlier building must have been. It seems to us, however, sufficiently apparent that the pillar or wall-shaft in question is not *in situ*, and that its present position is inconsistent with any possible plan of an earlier building on the site of the present one.

The shaft, with its capital and base, but not including the carving, belongs to the later years of the 12th century, and is therefore part of Jocelin's church, but on no reasonable hypothesis could it have been designed for its present situation. We should have to suppose the south wall of the church entirely removed, and a transept or east wall, where there could have been neither, in prolongation of the foot or two of wall to which the pillar is attached. But even these large and unwarrantable assumptions do not remove our difficulty. The capital is disproportionate to the height of the shaft, and its carving is apparently of later date than the moulding of the abacus and the base of the shaft. The pillar is inconsistent in itself, and a contradiction to everything in its vicinity. It is out of keeping with the pillar that adjoins it on the south wall, and equally incongruous with the impost moulding of the arched opening in the wall to which it is attached. Lastly, it is out of harmony with the whole vaulting of the compartment, and most of all with the superfluous vaulting rib which it carries. How then, it may be asked, is its existence to be accounted for?

It will be noted that the top bed of the capital is in line with the top of the other capitals of the compartment, while the table or bench on which the pillar stands is on the level of the bench of the south wall, though in other respects different from it. This fact, in conjunction with the complete incongruity of the pillar

otherwise with its surroundings and its obviously earlier date, seems to us to show conclusively that it is not *in situ*. Are we to suppose that a new Cathedral was designed to accommodate itself to the levels of an insignificant fragment of an earlier building, or are we to assume a marvellous double coincidence of levels of the earlier and later wall shafts? Either supposition is so absurd that the mere statement of the case is sufficient to discredit it.

To account for the preservation of a fragment of the 12th century building incorporated with the work of the 13th century,

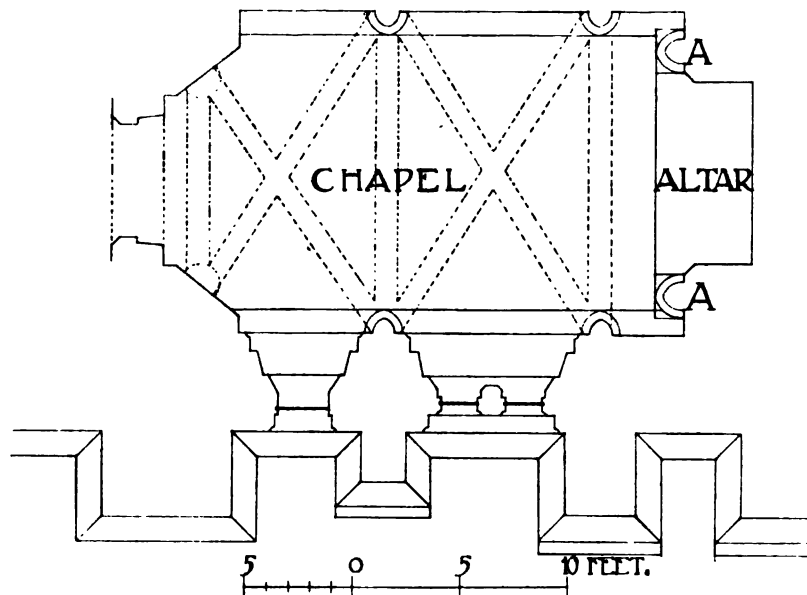


Fig. 12.

Plan of Walter's Chapel.

we must consider for a moment the course that would be followed in the process of demolition and reconstruction carried out by Walter. When it was decided to pull down what had been built of Jocelin's church and to erect a new Cathedral on the site, it was necessary, first of all, that a resting-place should be provided for the bones of Saint Kentigern—"a house of small magnitude" where might be "performed daily over his holy body, masses

together with the other services." The plans of Walter's building having been drawn, it was arranged that a portion of the structure should be devoted to this purpose. A section of the south aisle of the new building having been selected, a corner of the old choir was pulled down, and the south-west compartment of the new crypt was constructed in its place. This small chapel, for such it was to be during the erection of the new choir, was designed as part of the south aisle of the lower church, and was vaulted and roofed over at the level of the choir floor. An altar was erected against the east wall, and beneath this altar the relics of the saint were reverently laid. When these had been conveyed with due ceremonial to their appointed temporary resting-place the remainder of Jocelin's choir could be pulled down, and the construction of the new edifice proceeded with as a whole.

To economise the small area of the chapel, and to facilitate the future opening up of its east wall when it should become part of the south aisle, a recess was formed to receive the altar, and an arch was thrown over the recess. The builders naturally desired to impart some architectural adornment to the shrine of the saint, though its temporary nature precluded any great expenditure of time or money, and forbade its treatment as part of the design of the new Cathedral. But a portion of the earlier church had just been taken down, and the old pillar and arch stones were ready to their hands. They constructed, therefore, with the old stones, a pillar on each side of the altar recess A A (fig. 12), and formed an arch or outer order above the pillars and in front of the recess. For these pillars and this arch they used the old material of that part of Jocelin's church which they had just pulled down, and by this natural and simple means a certain dignity was imparted to the temporary altar and tomb of Saint Kentigern.

On the completion of the vaulting of the middle compartment, about 1260, the relics of the saint would be removed to their permanent resting-place in the middle of the crypt, the wall at the

back of the arched recess taken down, and the temporary altar cut through, so that the chapel became part of the south aisle of the lower church for which it had been designed. The outer arch over the altar recess was removed at this time with the pillar which had carried it on the north side, as it was necessary to reduce the dimensions of the reconstructed pier at H (fig. 10), in order to open up the arch of communication between the aisle and middle crypt at this point. The pillar on the south side, however, and a portion of the altar itself, were retained.

At this period of reconstruction, about 1260 or a little later, the vaulting of Walter's chapel was taken down and rebuilt on the original design, and mainly with the old voussoirs. The relic of Jocelin's church, the pillar A (fig. 10), was now useless, the arch which it had carried having been removed, and it might have been hewn away.* The builders, however, or those who directed the work, preferred to retain it, along with a portion of the altar, as a memento at once of Walter's chapel and of Jocelin's church, a building by this time fading out of recollection, and of which no other memorial remained to speak to future generations. To give the pillar some show of useful function a vaulting rib, A J (fig. 10), was carried from its capital to the crown of the reconstructed vault.

It may be asked whether it is probable that a memento of Jocelin's church and Walter's temporary chapel would have been preserved on no other ground than sentiment. It is true that other considerations may have weighed in regard to the retention of the fragment. The arch and the wall or jamb which carries it were now required to separate Walter's aisle and vault on the west from those of Bondington on the east, and it was more convenient to retain a portion of the old work than to take it down and rebuild the whole. The shaft itself might have been hewn

* The jointing of the south-east corner seems to indicate that the original intention when it was built had been that this fragment of eastern wall should be removed after its temporary purpose had been served.

off and the altar entirely removed, but to what purpose? There are, however, many instances in this country, in France, and above all in Italy, of fragments of buildings of the 12th century that have been preserved and built into the structures of the 13th century that took their place.* In the present case it was not even a question of preserving a memento of a building about to be destroyed, but of saving from destruction one that had already been preserved for forty years, of a building that lived only in the memory of a generation that was passing away.

It will be observed that one of the elements of the puzzle has been the table beneath the base of the 12th century pillar. This resolves itself into a portion of the altar which was cut through and faced up on the north side when the chapel became part of the south aisle. Where it has been cut through it has neither projection nor chamfer, but on the west side, the front of the altar, it has both, and is here of different section from the cavettoed projection on the bench of the south wall. It is probable that the stone may have belonged to an original tomb and altar of Jocelin's church, but if not, the difference between the chamfered projection of the altar and the cavettoed projection of the bench may be taken to indicate what was designed to be temporary as against what was permanent. There are marks of socket holes, now filled up, and these may have carried the fittings or adornments of the altar.

The pillar stones probably belonged to the aisle of Jocelin's choir, a portion of which had been pulled down to make way for Walter's chapel; and the shaft must have been of considerably more than its present height. The capital is a veritable hybrid. Originally of Jocelin's time, its carving seems to have been rudely and hastily done when it was adapted to its present

* "C'était d'ailleurs un usage assez ordinaire au moment de cet entraînement qui faisait reconstruire les cathédrales, de conserver un souvenir des édifices primitifs."—Viollet-le-Duc, "Dictionnaire de l'Architecture," Vol. II., p. 286.

position. Altogether the somewhat grotesque design and uncouth proportions of the pillar, its peculiar situation with its combination of 12th and 13th century workmanship, are perfectly accounted for on the supposition that has been advanced, and they are totally inexplicable on any other that has been suggested.

The wall shafts B and C (fig. 10), of Walter's time, have an edge or arris in front like Jocelin's pillar A, but they are of smaller diameter, and are otherwise of different proportions. Their capitals are wholly moulded, and follow the outline of the shaft. These pillars resemble the wall shafts of the nave, and the splayed wall base of the exterior, which begins in the middle of the broad buttress K (fig. 10), is continued due west through the transeptal crypt of later date and round the nave. Together the wall shafts and the wall base clearly establish the connection of Walter's chapel and the lower walls of the nave.

The pillars of the north side of the chapel F, G, and H (fig. 10) are of the period of the lower north and south aisles. It is evident that a wall and pillars of Walter's time must have existed here before the present pillars were built, and that a partial reconstruction of the chapel must have taken place about 1240, when the existing pillars were constructed. As we shall see afterwards, the springers on the north side of the pillars G and H are of 1240, while that on the north side of F is a springer of 1260 substituted for the original one of 1240.

The south-western part of the pier or pillar H (fig. 10) must have been completed when the chapel was thrown into the south aisle, and the architect has been somewhat embarrassed to know how to carry the north side of the arch A H without making the pier too large, and so obstructing the circulation of worshippers and the view of the central crypt. Fig. 13 shows how the difficulty has been evaded rather than overcome by a kind of double corbel, the springing of the arch having been reduced to admit of being carried on a corbel of reasonable size. The original pier at the

north side of the altar must have been such as to correspond with the one still existing on the south, and attached to it there would be another shaft* resembling A (fig. 10), and like it formed of material taken from Jocelin's church, while between the two pillars, and within the arched recess, extended the tomb and altar of the saint (see fig. 12). The arch or rib G H, the section of which is shown by fig. 14, is manifestly of the period of the final reconstruction of the compartment.

The temporary chapel of the south-west compartment, constructed about 1220, and having an altar recess adorned with pillar and arch stones from Jocelin's church of the end of the twelfth century, altered on the north side about 1240, and finally thrown into the south aisle of the crypt about 1260, would be approached by way of the south transeptal door, and perhaps also by a stair from the nave or transept, then only



Fig. 13.
Corbel in South-West Compartment.

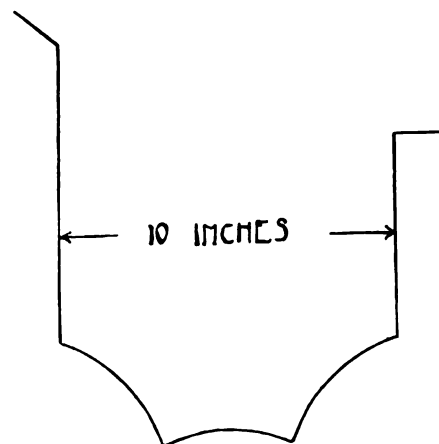


Fig. 14.
Section of Arch in South-West Compartment.

* Several loose fragments, some of which may have belonged to this shaft, are to be seen in the Chapter House.



Fig. 15.
South Transept Doorway.

partly built. The extended south transept, of which the crypt only has been built, is of course of later date, and its vaulting has been constructed in front of the transeptal doorway (fig. 15), the outer semi-circular arch of which has been removed to make way for the wall rib of the vault, while the lower portions of the outer pillars of the door have been ingeniously turned into dwarf vaulting-shafts. By this entrance, then an external door, or by way of the nave, we may assume that worshippers approached the temporary altar and shrine of the saint for a period of about forty years while the choir was rising from the ground. During this time the walls of the nave must have remained in the condition in which they had been left by Walter, while the choir and lower church were not yet available for the services of the church. Probably a temporary roof was constructed over the nave to shelter a congregation, and at the same time to protect the walls so far as they had been built.

The first suggestion of the use to which this part of the crypt may have been devoted is due, we believe, to Mr. Honeyman, who, however, describes the vaulting of the compartment along with the unique shaft as portions of Jocelin's crypt that had been preserved and incorporated with the later building. It is added that it was "probably the last safe repository of the sacred relics, or the last corner of the old building fit to worship in while the new choir was gradually rising."* Mr. Honeyman's ascription of the vaulting to the 12th century and the shafts of the south wall to the second quarter of the 13th century is singular, as these shafts and the vault which they carry are obviously of one date as to their design and original construction.

At the reconstruction of the vault a number of new stones have been introduced among the old voussoirs, and these may be distinguished by their larger size and more finished workmanship. The new rib, A J (fig. 10), has been constructed mainly of old

* Transactions of the Glasgow Archæological Society, New Series, Vol. I., Part 1., 1885.

voussoirs, the apex, where it joins B G, being formed of course in a new stone. Apart from this rib A J, the reconstructed vault follows closely on the original plan.

It may be added that as the chapel of Walter is plainly the earliest part of the lower church, so the aisle immediately above it is apparently the latest part of the choir. The window of the second bay from the west, immediately over the broad buttress previously referred to as the point of junction of Walter's and Bondington's work, is different from all the other windows of the aisle, being of four lights instead of three, with tracery and mullions of more developed character. This seems to indicate that the south-west chapel was roofed over temporarily and the aisle above delayed while the choir was under construction. The completion of this part of the aisle may have been in abeyance until the removal of the relics of the saint to their permanent resting-place in the middle of the crypt, under the ciborium of the four pillars which so beautifully marks and canopies the shrine.



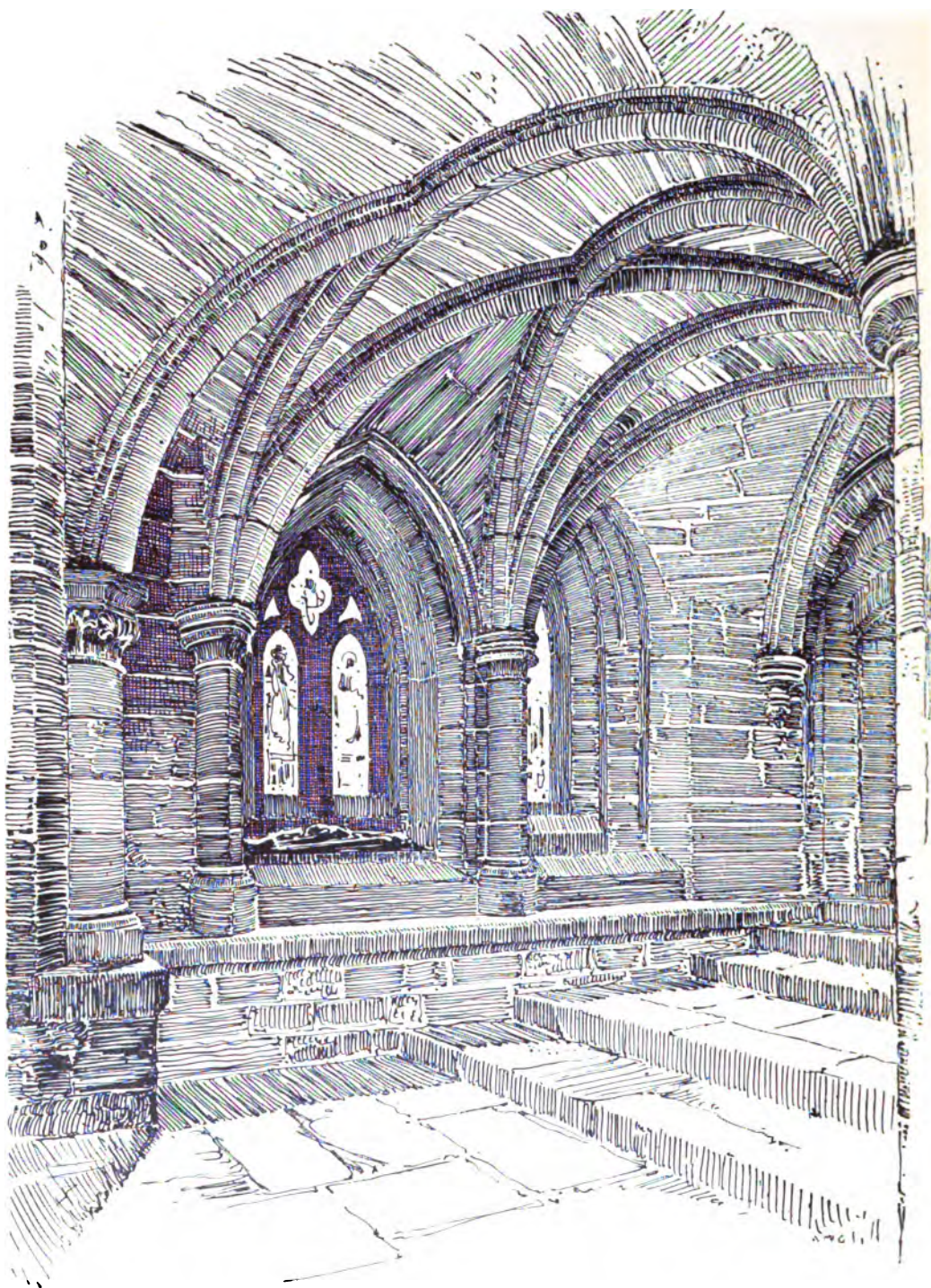


Fig. 16.

The First Period of the Vaulting—The South-West Compartment.

Chapter III.

*The First Period of the Vaulting, the South-West
Compartment of the Lower Church. Date circa
1220. A Mouldings, Fig. 5.*

FOR more than four hundred years the history of vaulting shows a continuous course of development in which one phase succeeded another in well recognised order. A closer parallel to its progress may be found in the domain of mechanical invention than in the architecture, and particularly the ecclesiastical architecture, of our own time. The vault was, in fact, a mechanical invention as well as a decorative system, and the changes which it underwent were primarily structural changes. As with many other mechanical inventions, its development shows a regular and consistent progression in which each new feature introduced marks a definite purpose in its adoption, and is subject in turn to further modification, one step following another in due order and sequence. It follows that to recognise the particular stage of development of a vault is at the same time to determine its date within certain limits, and subject to some qualifications.

Difficulties and exceptions, of course, are not wanting in vaulting or in any department of archæology. Some allowance must be made for local and accidental peculiarities; occasional instances there are of reversion to an earlier type, or of partial anticipation of a still undeveloped trait, but these are little liable to mislead anyone acquainted with the style and the conditions under which the work was produced. A more fertile source of error may be found in the fact that in continuation of an unfinished building it was occasionally necessary to conform in some measure to the original style

of the structure. This conformity, where it exists, is always of a partial and reluctant character; even where the general design has been adhered to some peculiarity of the period of the later work is almost sure to be found. The mouldings, in particular, are among the most sensitive parts of a design and the most subject to modification; they are, therefore, among the most reliable indications of the date of any part of a building.

In the case of vaulting, however, the indication of date which mouldings offer is sometimes wanting, or, rather, this indication may be misleading. When the walls of a building were constructed at one date, and the vaulting was delayed for a term of years, we usually find that the springers—the lower portion of the vaulting ribs—were built along with the walls to which they are attached. Where these have been retained without alteration the general design and mouldings of the whole vault necessarily adapt themselves to the original springers, and it follows that the work will be of the earlier character, though the actual construction, or completion, of the vault may have been delayed till a much later period. Even here, however, some evidence of the date of its completion may be found either in the vault itself or in the work immediately connected with it. In such a case we may have the early design carried out with the early mouldings, and yet be able to pronounce that the vault, with the exception of the springers, was not actually constructed until the later date.*

* A very interesting example is found in the cloister of Norwich Cathedral, begun about 1297 and completed in 1430. Broadly speaking, each of its four sides is of a different date, but the original design and mouldings of 1297 have been adhered to throughout the vaulting. Careful measurement, however, reveals a slight variation in the curvature of the ribs in each of the stages of the vault, a variation which reflects, though it does not follow, the changes of style during the period of 133 years over which its construction extended. While the general design and mouldings of the whole vault are thus of 1297, on three sides of the cloister this design has been almost imperceptibly modified by the practice of the successive periods at which they were constructed. The tracery of the openings into the cloister garth is varied on each side, and, unlike the vaulting, its design conforms frankly in each case to the period of its execution. See Willis "On the Construction of the Vaults of the Middle Ages," Transactions of "The Royal Institute of British Architects," 1842, and the Rev. D. J. Stewart, "Archæological Journal," volume 32.

The general practice of the middle ages was to complete the vaulting as the work proceeded; there are, however, numerous examples of delayed or reconstructed vaults, in some of which the original springers have been used without alteration, while in others they have been remodelled in a greater or less degree, or removed altogether to admit of a later style of vaulting being employed. In each case it is necessary in considering its design to take into account the influence which the earlier work has exercised over the later. This latter consideration, it may be added, is not confined to vaulting, but is of wider application. It is sometimes assumed that as each builder worked in the style of his own period, he worked also in disregard of the architecture of the earlier portions of the building; but this view is in great measure erroneous. The harmony that prevails between the earlier and later portions of our cathedrals is not accidental, and it is only partly due to the essential unity of the succeeding styles; the earlier work is recognised in the scale and proportions of the later, or it may be that a note or phrase from the former is taken up and repeated with such variation as may be required, so that one feels the later work to be truly a continuation of the earlier, however dissimilar in style it may be.

We are about to describe a series of examples of vaulting extending over a great part of the 13th century, and some reference to the origin of the rib vault and the progress of the art up to and including the epoch of which we treat is necessary. It would be impossible, within the limits which our subject imposes, to follow each step in the development of the early vault, or to recount the more important of the influences that went to mould the style. Even the briefest history of the vault would carry us far beyond the scope of the present work; but it may be possible to show in a few sentences the underlying tendency that in great measure controlled the structural changes that took place during the period of transition from the round arched surface vault of the

Romanesque era to the pointed rib vault of the 12th century. Following upon this we shall endeavour to indicate some of the progressive modifications that are illustrated in the several stages of the vault which forms the subject of our essay.

While surface vaulting was employed on a very large scale by the Romans, and with much less skill by the builders of the Romanesque structures of the middle ages, rib vaulting, which is essentially different in principle, is an invention of the 11th century which came into general employment during the 12th century. The fundamental distinction between the Roman, or Romanesque, and the Gothic methods of vaulting is that the arch, or vault, is continuous in the former and intermittent in the latter; in the one case we have accordingly vaulting surfaces, and in the other vaulting arches or ribs with filling-in pieces between the arches. Every stone or brick in the Romanesque vault has the same function to perform—that of a voussoir or arch stone; but in the Gothic vault the voussoirs proper are confined to a framework of independent arches, a constructive skeleton of vaulting ribs, on which the intermediate filling-in pieces of thinner, and sometimes of lighter, material rest. The Roman, or Romanesque, vault was frequently strengthened by arches either concealed within its thickness or exposed to view, but these are not to be confounded with the ribs of Gothic vaulting; however much they may strengthen, they do not carry the vault, which is, theoretically at all events, quite independent of them.

The Romanesque vault in its simplest form is a continuous semi-circular arch; in its less elementary manifestations it consists of intersecting arches of the same continuous character. If we assume two semi-circular vaults of equal width which intersect one another at right angles, and at the same level, the line formed by their intersection will be a flattened semi-ellipse, the width of which will be nearly three times its height. Fig. 17 is a sketch and diagram of such intersecting vaults, the plan of which is shown

at A B C D. At *a b* we show the cross section of either of the vaults A B or B C, and at *a c* the diagonal section on the line A C or B D of the plan. This line of intersection of the vaults is marked by an angle, or groin, as it is called, which follows the semi-elliptical curve *a c*; beginning as a right angle at the springing, it almost disappears at the crown of the vault.

The flattened semi-ellipse of the diagonal is obviously a weak form, as well as troublesome in construction, and innumerable experiments were made with a view to strengthen this line of greatest weakness in the vault. The ultimate result of these efforts, continued over many years, was the introduction of a diagonal arch to support the angle, or groin, of the vault.

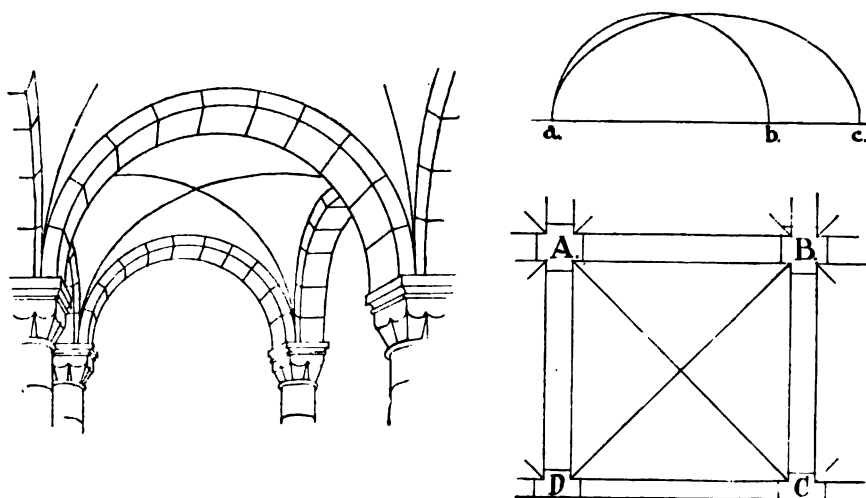


Fig. 17.

Sketch and Diagram of Romanesque Vault.

The particular time, place, and manner of the first use of the diagonal vaulting arch, one of the most revolutionary inventions in the history of architecture, are unknown; it is uncertain even how far the purely constructive, and how far the decorative, motive may have influenced its adoption.* However reached, the con-

* See Viollet-le-Duc, *Dictionnaire de l'Architecture*, article "Construction," and papers by Mr. John Bilson, F.R.I.B.A., *Transactions of the Royal Institute of British Architects*, 25th March and 15th April 1899.

struction of the first arch, not reinforcing merely, but carrying the vault, was the admission of a new principle with far-reaching results ; it was the origin of rib vaulting, and heralded the appearance of Gothic architecture.

Transverse and longitudinal arches enclosing a vaulting compartment had been in existence since the time of the Romans, but with the introduction of the arch beneath the diagonal or groin they speedily assume a new function. Instead of merely strengthening the vault, the arches are made to support it wholly ; from this time the vault ceases to be a continuous arch and becomes a structure of independent arches or ribs ; the masonry between the arches, in place of carrying itself and constituting the vault, is carried on the arches and becomes no more than the filling-in of the interstices of the vault.

We have seen that the diagonal or groin of the Romanesque vault was elliptical in outline ; when, however, we substitute an independent arch for the angle of intersection of two curved surfaces, we may give the arch what form we please within certain limits. The flattened elliptical outline, being constructively weak and unsatisfactory to the eye, is quickly discarded, and a curve consisting of a portion or portions of a circle is substituted for it. The process of designing the vault is reversed, and in place of setting out the surfaces and leaving the groins to result from their intersection, we proceed by setting out the ribs and leave the surfaces largely to take care of themselves. Instead of being cylindrical and continuous, the surfaces become irregular and non-continuous. While, therefore, in the Romanesque vault the surfaces were regular and the groins irregular or complex curves, in the ribbed vault the groins are usually regular or simple curves and the surfaces irregular or twisted. Henceforward the constructive function belongs to the vaulting arches, and the design depends on them ; the surfaces or panels merely occupy the intervening spaces, and are therefore of secondary importance.

Having become non-continuous as to their form, the intermediate surfaces of the vault soon become equally so as to their construction; in place of passing over the vaulting arches, as they did in the earlier vaults, the panels are now fitted between the arches and carried on rebates cut in the latter. The change is shown at Fig. 18, where A illustrates the continuous Romanesque vault with its transverse arch beneath, and B the Gothic vault with separate non-continuous panels carried on the vaulting arches. The vault is no longer a simple homogeneous mass carried directly on the walls and pillars; it has become a complex structure of arched

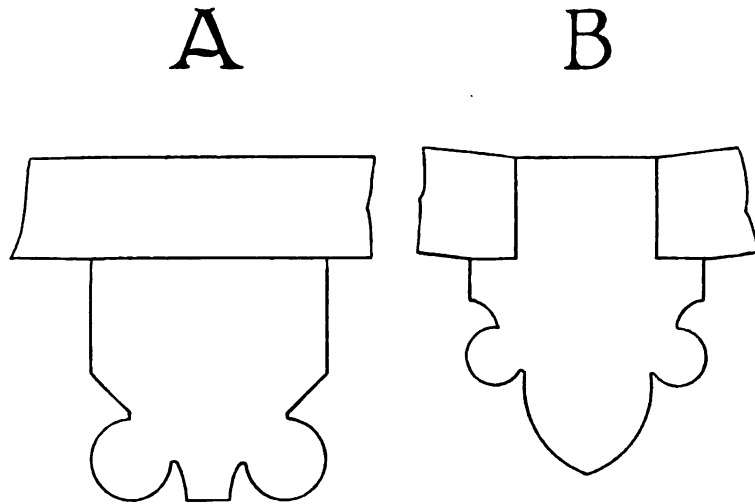


Fig. 18.

Continuous and Non-continuous Vaulting.

ribs with separate, triangular, concave, and curved panels between, while its weight is carried on the ribs, and by their means concentrated on fixed points of resistance. A change of system so complete had to find expression in the development of new features, and eventually of a new style of architecture.

The transition from the round arched to the pointed style occupied the greater part of the 12th century, and was not yet complete when, in the early years of the 13th century, Bishop Walter began to build. It is impossible to compress the history of a hundred

years into a few pages, but we may describe certain typical vaults of the 12th century, which will help to bridge the interval between the Romanesque and Gothic vaults.

Our starting point is the round arched vault of the end of the 11th century. On the introduction of the diagonal arch, as we have seen, the elliptical groin of the Romanesque vault was replaced by an arch, and this arch, while in the experimental stage, assumed a variety of form and proportion. In many instances it followed, as we should expect, the semi-circular form which prevailed at the time, and this resulted in a type of vault with diagonal, transverse, and wall ribs all of the semi-circular form.

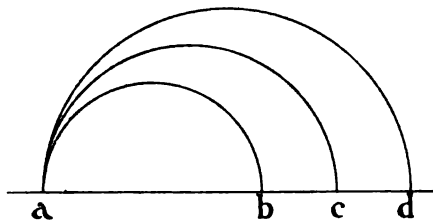
Fig. 19 shows this vault of the three semi-circular arches in the diagram X. We have assumed an aisle 12 feet in width, divided into vaulting severies of 9 feet. A B C D is the plan of one of these severies, and applies to each of the diagrams X, Y, and Z. The wall ribs A B and C D are 9 feet wide, the transverse ribs A C and B D are 12 feet, and the diagonal ribs A D and B C 15 feet in width. When these three arches are semi-circular, and spring from the same level, they rise necessarily to different heights as shown in elevation by the diagram X, the wall rib *a b* being $4\frac{1}{2}$ feet, the transverse rib *a c* 6 feet, and the diagonal rib *a d* $7\frac{1}{2}$ feet in height from the level of the springing to the crown of the arches.

This diversity of height, however, involved some inconvenience; the diagonal, being higher than the transverse rib, requires that the floor or roof over the vault should be at a higher level than would otherwise be necessary; while the wall rib, being lower than the transverse rib, restricts the height of the windows in the outer wall, and of the arches of the main colonnade, and so interferes with the lighting of the building.

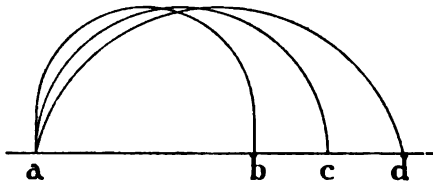
An effort has to be made, therefore, to secure greater uniformity in the height of the vaulting arches. Leaving the transverse rib *a c* as it is, we raise the wall rib *a b*, diagram Y, to the same

level by inserting vertical pieces beneath it—by stiling it, as it is appropriately called; for the diagonal rib of $7\frac{1}{2}$ feet we

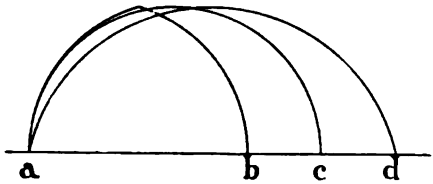
substitute one of 6 feet in height, consisting of a segment of less than half a circle. By this means we secure a vault with arches of a uniform height of 6 feet, as shown at Y; the transverse rib *a c* remains a semi-circle, the wall rib *a b* is a stilted semi-circle, and the diagonal rib *a d* is a segmental arch struck from a centre beneath the level of the springing of the vault.



X



Y



Z

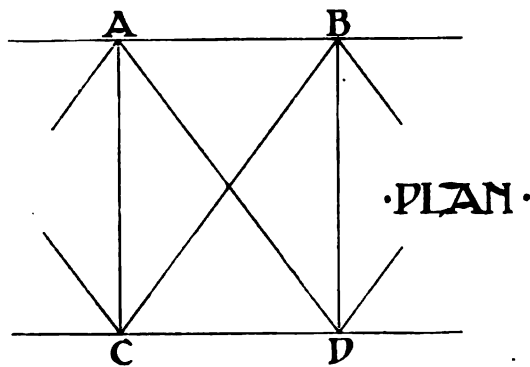


Fig 19.

Vaults with Semi-circular Transverse Ribs.

There was attained thus, as the result of numberless experiments and tentative efforts, a type of vault with the three arches of one height. Further consideration shows, however, that it is still crude and imperfect—that, in particular, the springing of the three ribs from the capital of the vaulting shaft is awkward and inharmonious. The wall rib *a b* rises vertically for a short distance above the capital, while the

diagonal rib *a d*, struck from a depressed centre, starts immediately and somewhat abruptly away from the vertical line. The two ribs are incongruous and produce an unpleasing springer, while the panel or filling-in piece between them is, of necessity, somewhat violently distorted. Obviously the result is still unsatisfactory, and further change is demanded.

It is easy to see now, and there must have been even then some imperfect recognition of the fact, that what is required to improve the springer is that the curvature of the three ribs should be more closely approximated. Our third diagram of Fig. 19 shows an important step in this direction, and brings us to another stage in the development of the vault. By the substitution of a pointed wall rib *a b*, diagram Z, for the stilted semi-circle of the preceding diagram, the defect of the springer is greatly mitigated, though not yet entirely removed; the vertical part of the wall rib is eliminated, its curve is closely approximated to that of the transverse rib *a c*, and it is brought so much nearer to that of the diagonal rib *a d*.

The springer is not yet satisfactory in respect of the difference that remains between the curvature of the diagonal *a d* and that of the other two arches; but we have made an important step in advance, a step which consists in the introduction of the pointed form in the narrowest of the three vaulting arches.

To realise the full import of this change, it must be remembered that the wall rib practically determines the form of the greater number of the arches throughout the building; the window and other openings of the outer wall, and the main arcade which separates the aisle from the middle area of the building, are governed by the outline of the wall rib, and with the wall rib they naturally assume the pointed form. The change from Y to Z, Fig. 19, is therefore, in effect, the change from Romanesque, with its semi-circular arches, to the pointed style. However simple the transition may appear as we have stated it, it was really a change of great importance, bringing with it many and difficult problems for solution, and involving

ultimately the complete breaking away from the tradition that had so long bound architecture to the semi-circular arch inherited from the Roman builders.

Much has been written of the so-called invention of the pointed arch, the origin of which has been fancifully ascribed to a great variety of sources. The form itself, however, must have been known from the earliest time, and even in architecture its use may be traced to a remote age. The real invention of the middle ages was the architectural system founded on the pointed arch, a system due to the introduction of rib vaulting. The advantage which the pointed form offered in reducing the outward thrust of the vault was an inducement to its adoption that existed even before the invention of rib vaulting, and, in fact, the pointed arch had obtained a certain hold—in the south of France, for example—before much progress had been made in rib vaulting; but it was the development of this method of vaulting, with the necessity which it imposed of arches of varying span and nearly uniform height, and of similar curvature at the springing, that compelled the systematic employment of the pointed arch.

Fig. 20 is a diagram of the south-west compartment of the lower church, the earliest of the five periods of the choir vaulting, from which it will be seen that it consists of semi-circular, segmental, and pointed arches, and is of the type represented by the diagram Z, Fig. 19. The transverse rib B G, the elevation of which is shown by B L G, is nearly a semi-circle; the other transverse rib, C F, shown in elevation by C M F, being a foot wider than B G and of equal height, is slightly flattened, while the rib D E, at the contracted part of the vault, assumes the pointed form D N E. The diagonal ribs C G and B F, the former shown in elevation by C P G, are segmental, and have been drawn from centres about three feet lower than the springing of the vault. The other diagonals, D F and C E, the former shown by D O F, are broken segments, one side being necessarily longer than the

other. The half diagonal A I, added at the reconstruction of the vault, forms one-half of a semi-circular arch, as shown by A R.

The wall ribs, as represented by the window arches and the arches F G and G H, are, of course, pointed; but with one exception they are independent of the vaulting springers, and this exception, the arch G H, is not part of the original vault, but belongs to the period of its reconstruction. We have described

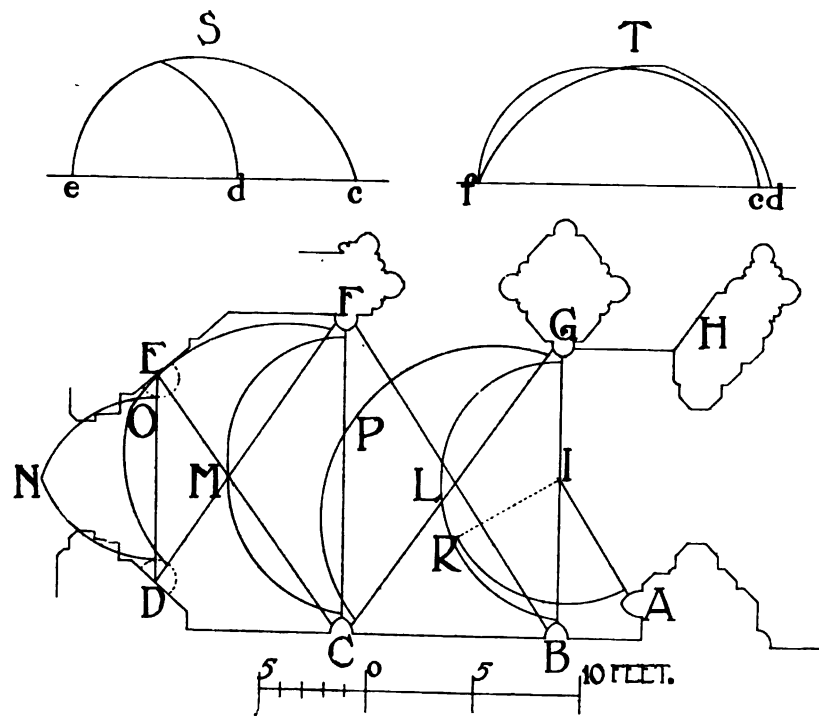


Fig. 20.

Vault of South-West Compartment.

the vaulting as of about 1220 originally, the pillars F, G, and H as of 1240, and the final reconstruction of the vault as having taken place about 1260. The south-west part of the pillar H, and the skewed arch G H which it carries, belong to this reconstruction, and the latter is finished on the side next the aisle with a moulded arch or wall rib which rises on one side from the springer

G, and on the other from the corbel H shown by Fig. 13. We do not require the evidence of a moulding to prove that this arch is of the date of the reconstruction, but it may be noted that it is of the section shown at Fig. 14, a moulding which could not have been employed, we think, earlier than about 1260.

Apparently the springers of the south side of the aisle, B and C, Fig. 20, have not been disturbed, while those of the north side are of the period of the reconstruction of the vault. As we should expect, the ribs which rise from the latter are much twisted, while those of the south side of the aisle are comparatively true in direction. We shall have a number of twisted or deflected ribs to examine in the later part of this volume, and note in this place the difference between the deflection of the ribs of the south-west compartment and those of the middle vault. In the former we have an early vault that has been rebuilt, and that in its rebuilding has had to accommodate itself to the design of the later pillars which support it on the north side. The twisting of the ribs is rather part of the design of the reconstructed vault than a change of design during construction; it applies to the whole rib and is without abruptness. In the middle compartment, however, we have had no reconstruction of the vault; the pillars remain as they were built, and a number of the original vaulting springers have been retained. A new design has been thrust on the old springers, and the altered direction that has been given to the ribs begins at the upper bed of the springer. We have therefore an abrupt, in place of a gradual, change of direction, and the ribs are rather distorted than merely twisted.

The springer G, Fig. 20, is of interest also in its bearing on certain of the problems of the middle vaulting, where there are many instances of earlier and later mouldings growing together on the same stem. We have here the mouldings A 1, A 2, Fig. 5, and the arch shown by Fig. 14; there are thus two mouldings of 1220 and one of 1260 combined in one springer. The obvious

fact of the reconstruction of the early vault about 1260, when the springer in question was wrought, offers a simple explanation of the incident, and will help us to understand its frequent recurrence in the middle vaulting.

At S and T, Fig. 20, we show the curvature of the ribs rising from the springers E and F on the plan. In the former of these diagrams *e d* shows in elevation the pointed arch E D on the plan, while *e c* shows the diagonal E C. It will be observed that the two curves are nearly coincident at the springer, like those of *a b* and *a c* of the diagram Z, Fig. 19. The springer F, as shown in elevation at T, is not equally happy. The curvature of the semi-circular transverse rib F C, and that of the broken segmental diagonal F D, given at *f c* and *f d*, do not nearly coincide, and in this respect resemble *a c* and *a d* of the diagram Z, Fig. 19. The result is a somewhat unsatisfactory springer, as may be seen in the photograph, Fig. 9.

It is impossible to bring such incongruous elements as the pointed and segmental arches into harmonious combination at the springer, and we find here a defect of the early type of vaulting represented in Walter's chapel. Even with the pointed transverse ribs and semi-circular diagonals of the succeeding period, as shown by Bondington's lower aisles, the springer still leaves something to be desired. The perfected springer, towards which the designers were groping their way, requires a still greater approximation of curvature in the vaulting ribs that compose it, and is only attainable when the pointed form has taken full possession of the vault.

Next to the mouldings, and sometimes even before the mouldings, the curvature of the ribs and the composition of the springer may be accepted as an index to the character and date of a vault. An earlier plan may have been followed and obsolete mouldings employed, but the combination of the vaulting ribs in the springer and the method of their disengagement are usually safe indications of the period of the construction of a vault.



Fig. 21.

The Second Period of the Vaulting--The Lower Aisles.

Chapter IV.

The Second Period of the Vaulting, the North and South Aisles of the Lower Church. Date circa 1240. B Mouldings, Fig. 5.

AFTER the completion of Walter's chapel, now the south-west compartment of the crypt, the demolition of Jocelin's choir was proceeded with and the foundation and under building of the new choir begun. At the death of Walter in 1232 the condition of the work must have been somewhat as follows :—The lower walls of the nave and transepts had been built, the south-west compartment of the crypt with its vaulting and temporary roof had been constructed and was occupied as a chapel ; the walls of the choir otherwise had not been begun—or if any part of them had been carried above the ground this must have been removed by his successor.

With the appointment of Bondington in 1233 a new policy seems to have been inaugurated. The work on the nave was suspended, and a revised plan, in the more developed style then current, was prepared for the choir and lower church. Bondington directed his whole attention to the choir or presbytery of his church, recognising probably that the resources of the See did not permit of the simultaneous construction of the nave and choir.

In a few years the level of the lower vault was reached, and about 1240 we come to the second stage of our vaulting, the north and south aisles of the lower church. In the interval of about twenty years which separates it from the preceding stage a great advance had taken place in the art of vaulting, greater facility having been acquired, and lighter and more graceful

proportions evolved. The somewhat ungainly character of the south-west compartment had given place to the more refined and finished style of the aisles.

We have seen that in Walter's vault the transverse ribs were semi-circular, while the diagonals were segmental arches. The designers had still a strong attachment to the semi-circular form, whose employment till recently had been almost universal, but it was found that some inconvenience resulted from its use in the transverse arches of the ribbed vault. Among other objections we may note the fixed and invariable relation of height to width, the flatness of the diagonals which it entailed, and the difficulty of constructing a satisfactory springer where one of the arches was a segment of less than half a circle.

The next important development was to transfer the semi-circle from the transverse to the diagonal arch, discarding wholly the segmental arch drawn from a depressed centre. This change represents another step in the encroachment

of the pointed form, as at this stage of vaulting a semi-circular diagonal implies that the transverse and wall ribs shall be pointed arches. A new and typical form of vault was thus introduced, whose characteristic is that the diagonals are semi-circular, while the other ribs are pointed arches of about the same height as the diagonals.

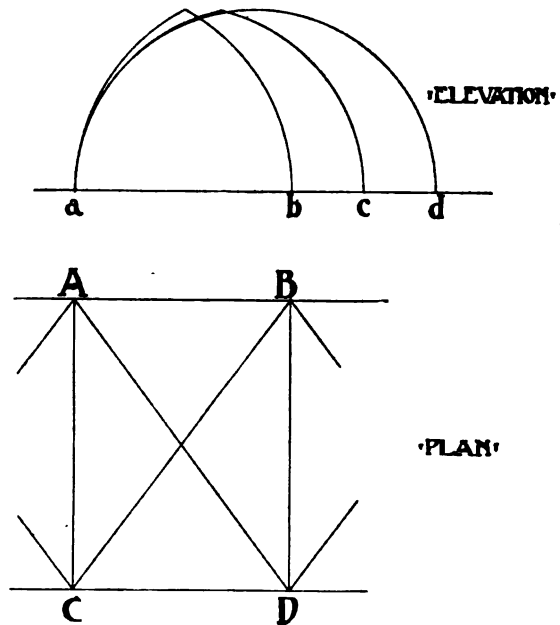


Fig. 22.

Vault with Semi-circular Diagonals.

Fig. 22 is a diagram of this vault on a plan similar to that of Fig. 19. The wall rib A B and the transverse rib A C are shown in elevation at *a b* and *a c*, while the semi-circular diagonal, A D on plan, is given at *a d*. A comparison of this figure with the diagrams X, Y, and Z of Fig. 19 will show how considerable has been the advance. The ribs are now nearly coincident in curvature at their junction, as shown at *a*, Fig. 22; the result is a graceful and vigorous springer, though one that still falls short of the perfect adjustment which belongs to the period now

imminent, when all the vaulting arches are to assume the pointed form.

The vaulting of Bondington's lower aisles is of the type we have described, that illustrated by Fig. 22, and a plan of one severy of the vault is given at Fig. 23. The diagonals A D and B C, the former shown by A *d* D, are nearly semi-circular, while the transverse ribs A C and B D, the former shown by A *c* C, are pointed, their proportions being regulated by the width of the aisle and the height of the diagonal. The

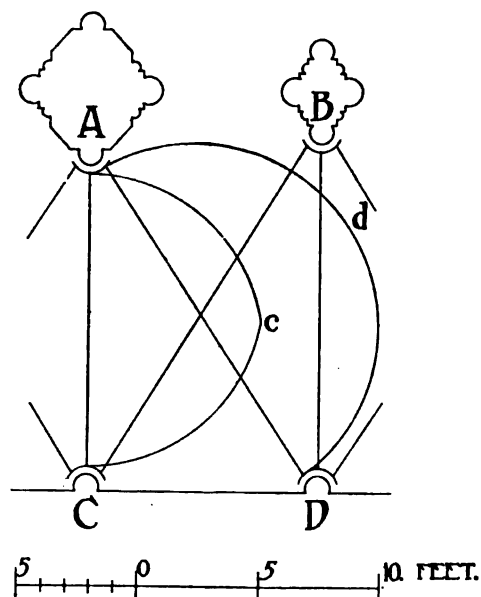


Fig. 23.
Vault of Lower Aisle.

wall ribs, if they can be so described, are independent arches and do not enter into the composition of the springer, but their proportions are equally dictated by the plan of the vaulting severy and the elevation of the diagonal ribs.

The semi-circular arch having been transferred from the transverse to the diagonal rib, the new type of vault required more height than the old. Bondington's architect accordingly kept his

capitals twelve inches lower than Walter's, and he made the crown or apex of his vault six inches higher than the other, by this means gaining a foot and a half in the height of his vault as compared with that of Walter (see Fig. 4). Even with this additional height Bondington's diagonals, like Walter's transverse ribs, fall short of being full semi-circles, but in both cases the approximation is very close. By lowering the floor of his crypt he was able to maintain a suitable proportion between the height of the pillars and that of the arch of the vault, and to this lowering of the floor the fall of the ground in an easterly direction fortunately lent itself.

The walls and main pillars of the lower church, including the three pillars on the north side of Walter's chapel, were constructed by Bondington at this time; the vaulting of the north and south aisles was completed as we now see it (Fig. 24); the springers of the middle and eastern vaulting, with a few exceptions, were formed, but the vaulting itself of these sections was delayed in order to facilitate the construction of the choir above. It is hardly necessary to repeat that the whole of the lower vaulting was designed at this time, and that the springers, so far as then executed, were of the same type as those of the north and south aisles; they were composed in the same manner and of the same mouldings, B₁ and B₂, with the addition of a third moulding of the same class, shown at B₃, Fig. 5.

When the middle vault was constructed, some twenty years later, the springers of 1240 were altered so far as necessary to adapt them to a new design, and at this time the later mouldings, C and D, Fig. 5, were introduced among the earlier ones; subsequently, when the eastern vaulting was completed, a still later type of vaulting rib, E, Fig. 5, was employed. We find, therefore, in the middle compartment mouldings of the B, C, and D types, and in the eastern vaulting mouldings of the B and E varieties. The original, altered and renewed springers of the middle and



Fig. 24.
South Aisle of Lower Church.

eastern sections of the lower church fall to be considered with the later stages of the vaulting and in connection with the recovery of the original design of the vault. It is important, however, that we should be able to form a clear idea of the condition and appearance of the springers before their alteration and before the introduction of the later mouldings. To obtain this we have only to look at the aisle vaulting, the subject of the present chapter, where we find the completed work of 1240, with, of course, its original and unaltered springers. These must be examined therefore with some minuteness, and the principles which govern their design considered. To those who are conversant with architectural detail the admixture of late and early mouldings in the later stages of the vaulting will present no difficulty, but merely add to the interest of the work. We desire, however, to make the subject clear to those who are unversed in the technicalities of Gothic architecture, and proceed therefore to note briefly some of the characteristics of a springer of 1240; more particularly to examine the springers of the lower aisles. As these springers are of the simplest description, without wall ribs and without coursing either horizontal or radiate, being formed in one stone, they are well adapted to the illustration of the elementary principles of the springer; as they are unaltered springers of 1240 they will serve as a basis of comparison with the springers, originally of that date but altered about 1260, which we shall find in the middle compartment.

With the introduction of the pointed arch the power had been achieved of adapting the vault to every variety and every irregularity of plan; with the infinitely variable proportions of the pointed form it became comparatively easy to apply the vault to every peculiarity of outline that a building could assume. This implies, of course, a great flexibility of design in the springers, and we find that, even when the building was perfectly regular, each of the springers was separately composed for its particular situation.

Where we have a range of vaulting in which one severy or vaulting compartment repeats another with almost perfect uniformity it might be supposed that we should have a series of identical springers, but examination will usually reveal something more than shades of difference; although composed of the same rib mouldings, each springer has been separately combined with reference to its particular situation, and adapts itself to even the smallest variation or irregularity of the plan. By what means this result was secured we shall endeavour to illustrate by means of the example before us.

From the plans of the lower and upper churches, Fig. 2, and the sections, Fig. 3, it will be seen that every second pillar of the lower aisles has to carry a pillar of the choir above; the inter-

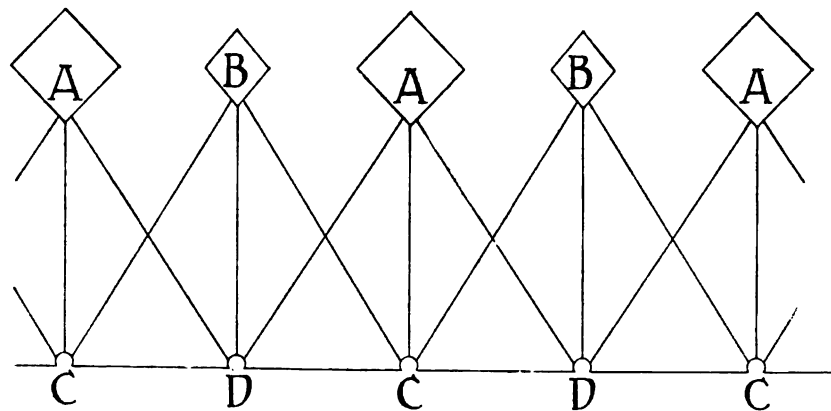


Fig. 25.

Diagram of Lower Aisle Vault.

mediate pillars have nothing but their arches and vaulting, with the floor of the choir, to carry, and they are therefore much smaller than the others. In the vaulting of the lower aisles the architect had thus a larger and a smaller pillar alternating on one side of the aisle, while on the other side the vaulting shafts attached to the wall were uniform and of course in line with one another. The transverse ribs which spring from the larger pillars are accordingly of rather less span than those which rise from the others,

while the diagonal ribs which spring from the larger pillars are also of less span than those which spring from the smaller ones. The diagram, Fig. 25, shows further that the diagonal ribs springing from the larger pillars A A are set out at a slightly different angle from those of the smaller pillars B B, while the diagonals rising from the wall shafts on the opposite side of the aisle spring also at different angles. The larger angle is found on the diagonals which spring from the larger pillars and the smaller angle on those

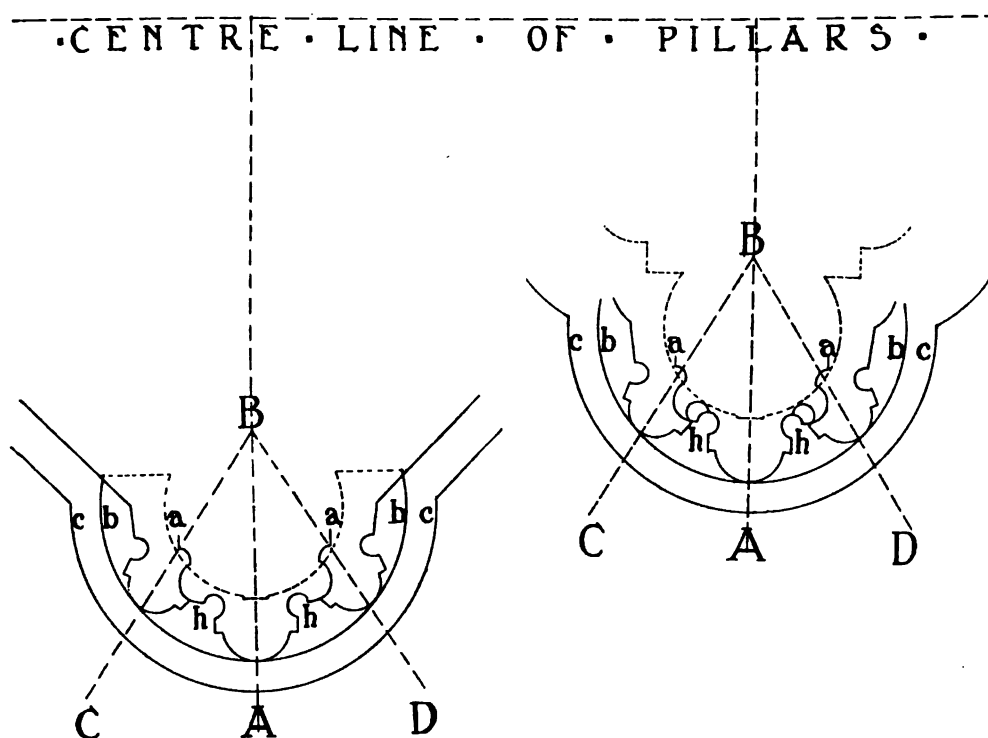


Fig. 26.

Plan of Springers of 1240.

of the wall shafts opposite them, while the smaller pillars have the smaller angle and the wall shafts opposite them the larger. Thus D A D and A D A, Fig. 25, are the larger angles, while C B C and B C B are the smaller ones.

In Fig. 26 we give a detail of two of the springers of the lower aisles, that is, of unaltered springers of 1240, from the larger and

smaller pillars respectively. The inner dotted circle *a a* in each case shows the vaulting shaft, while the outer circle *c c* gives the line of the abacus or upper member of the capital. Between these, and about two inches within the latter, there is a third concentric circle *b b* which confines the mouldings that compose the springer. This is not an imaginary line merely, but will be found, with certain other markings, cut or scratched on the top bed of most of the capitals; it may be noted also that the shafts, capitals, and the circles bounding the springers are similar on both sides of the pillars, on the side next the middle compartment and on that towards the aisles.

The process followed in setting out the springer is of much interest. The centre line of the transverse rib A B, Fig. 26, having been drawn through the centre of the pier and at right angles to the main axis of the vault, the builders proceeded to apply a template of the rib moulding, a pattern cut out in some thin hard material, on the centre line, so that the front or lower edge of the moulding should touch the circle *b b*.* The outline of the moulding, which is that shown at B1, Fig. 5, was then scratched on the bed of the springer by a pointed tool worked round the edge of the template.

With a view to setting off the diagonals to their respective angles, the point B, from which they are to radiate, falls now to be determined, and this point, for reasons which are beyond the scope of our present description, does not coincide with the centre of the shaft and capital, but is situated within the main body of the pier. In the present case the point is about five inches behind the centre of the vaulting shaft. The centre lines of the diagonals B C and B D may now be drawn, their angles in each case being laid down to the actual direction of the rib. This angle, as we have seen, is varied on the alternate piers and wall shafts of the aisles, and there is in addition the usual irregularity in the setting

* In a few of the springers only the mouldings are set off a little within or beyond the circle *b b*,—in the large majority of cases they just touch it.

out of the building, so that no two springers of the series are absolutely identical. The template of the diagonal rib, B₂, Fig. 5, is now applied on each of the diagonal centre lines, its front or lower edge, as before, touching the circular bounding line *b b*, and so much of the outline as may be required is scratched on the bed of the stone. When this has been done for both diagonals—there being no wall rib in the present case—the outline of the lower bed of the springer is complete, subject to any slight adjustment that may be required at the junction of the mouldings with one another and with the adjoining arches.

It would take too long to describe the process of setting out the upper beds of the springers and the preparation of face-moulds or templates for the springer and voussoir stones, and as our present purpose is merely to illustrate the principle on which the springers were combined, and the adaptation of each to its position on the plan, such description is unnecessary.*

The lower member of each of the rib mouldings, B₁ and B₂, Fig. 5, consists of a roll or round, with fillets on each side, and it will be seen that this member is still entire at the bed of the springer, while the upper or side members of each moulding are absorbed in one another, to be disengaged gradually as the ribs diverge in rising from the capital. At the springing the filleted rolls are separated from one another by hollows, *h, h*, Fig. 26, and in comparing the springers of the aisles it will be found that these hollows vary in width from about three-quarters of an inch to two or two and a half inches.† As we should expect, the hollows are generally wider at the larger angles D A D and A D A, Fig. 25, than at the smaller ones C B C and B C B; but

* For fuller and more technical information on the subject the reader is referred to Willis "On the Construction of the Vaults of the Middle Ages," Transactions R.I.B.A., 1842, and Viollet-le-Duc, Dictionnaire de l'Architecture, articles "Construction," "Ogive," "Trait," "Voûte," &c.

† In the springers of the narrow western aisle these hollows disappear altogether.

apart from this there is a considerable irregularity in the width of the hollows even where there is no apparent reason for variation.

The explanation of this irregularity is found in the fact that each springer was described independently of the others with the help of templates for each of the ribs; the springers were composed by placing the templates of each rib successively on the bed of the stone and tracing the mouldings, or so much of them as might be required. The adjustment of the ribs to one another was therefore varied as the circumstances required. It is not too much to say that some part of the beauty of Gothic vaulting is due to this slight irregularity of the springers—to the fact that each rib is set off to its true direction, and possesses a certain independence even of those with which its existence merges at the springer. Further, as each rib was set out to the precise direction which it was required to take, there was no necessity for further adjustment during its construction. In the normal vault of this particular period there is accordingly little or no twisting of the ribs, each of which is set out at the springer to its proper angle and direction.

The springers of the aisles and those of the middle compartment are about 2 feet 4 inches in height, and usually in one stone. The absence of wall ribs and of horizontal or other coursing has relieved the designer of some of the usual difficulties of the springer, and greatly simplified the work of the stone-cutters. At the upper bed the rib mouldings have almost disengaged themselves from one another; from this point each rib becomes an independent arch, and is constructed in the same manner as any other arch. As the aisle vaulting has never been altered or reconstructed, the ribs remain generally true in curvature and direction except where they have been dislocated by the unfortunate thrusting out of a portion of the walls, or by some other movement of the building. The transverse ribs, though alternately of different span, appear to have been described with the same radius, an obviously convenient and economical arrangement, as the same face-mould

would serve for both, and the voussoirs or arch stones as they were wrought might be used indifferently for either. The same method seems to have been applied to the diagonal ribs, the span of which is varied in alternate pairs. In points like these we recognise a designer versed in the technicalities of his craft, and capable of applying the labour at his disposal to the greatest advantage. The springers are carefully designed and well proportioned. The curvature of the diverging ribs immediately above the capital falls short of the perfect assimilation that was afterwards attained; in other respects the work shows full command of the art, and the defect, if such it can be called, is one that belongs to the period.

We have dwelt a little on the unaltered springers and vaulting of the north and south aisles of the crypt, as in subsequent chapters we shall have occasion to refer to the springers of the same period that have been adapted to the vaulting of a later date. In the case of the eastern aisle the general design of 1240 has been closely followed, and many of the springers have been left in their original condition; so far as we can judge, however, the only vaulting wholly of this date that exists in the building is that of the lower north and south aisles.

Altogether we find in the earlier portion of Bondington's work a good example of the period just before the art of rib vaulting had reached maturity, before the pointed arch had been generally adopted for the diagonal ribs, and before the introduction of the ridge rib. The intersection of the diagonals is marked by finely carved bosses, and the whole design is well conceived and excellently carried out. The alternation of larger and smaller pillars, and the slight variation in span of the transverse and diagonal arches consequent thereon, relieves the regularity of the vista, while its graceful proportions and carefully studied detail show the designer to have been a worthy member of a fine and, at the same time, a rapidly-progressive school of architecture.

Chapter V.

The Third Period of the Vaulting, the Aisles and Chapels of the Choir. Date circa 1250. B and C Mouldings, Fig. 5.

LEAVING the lower work unfinished as to the middle and eastern vaults, Bondington carried up the walls and pillars of the choir, and constructed the upper vaulting which is confined to the aisles and retro-choir or eastern chapels; he then completed the clerestory walls and, it may be assumed, covered the aisle vaulting and closed in the middle area of the choir with their wooden roofs. When this was done, the outer shell of the building was practically finished, and the builders might devote their attention to the completion of the lower vaulting, and the internal furnishings of the building. Between the lower aisle vaulting of 1240 and the upper vaulting, the subject of the present chapter, there is an interval of about ten years, and between the upper vaulting and the lower middle vault there is another interval of the same duration. From the level of the choir floor upwards the building therefore occupied the years from 1240 to 1260, and the vaulting of the upper aisles dates from about the middle of that period. The evidence as to the several dates is given in the description of each section of the vaulting and in the chapter on the mouldings, while the reason for the postponement of more than half of the lower vaulting is considered in the ninth chapter. In the meantime we content ourselves with recording the facts.

While the upper choir was in process of construction the position of the lower work was broadly as follows:—The pillars of the

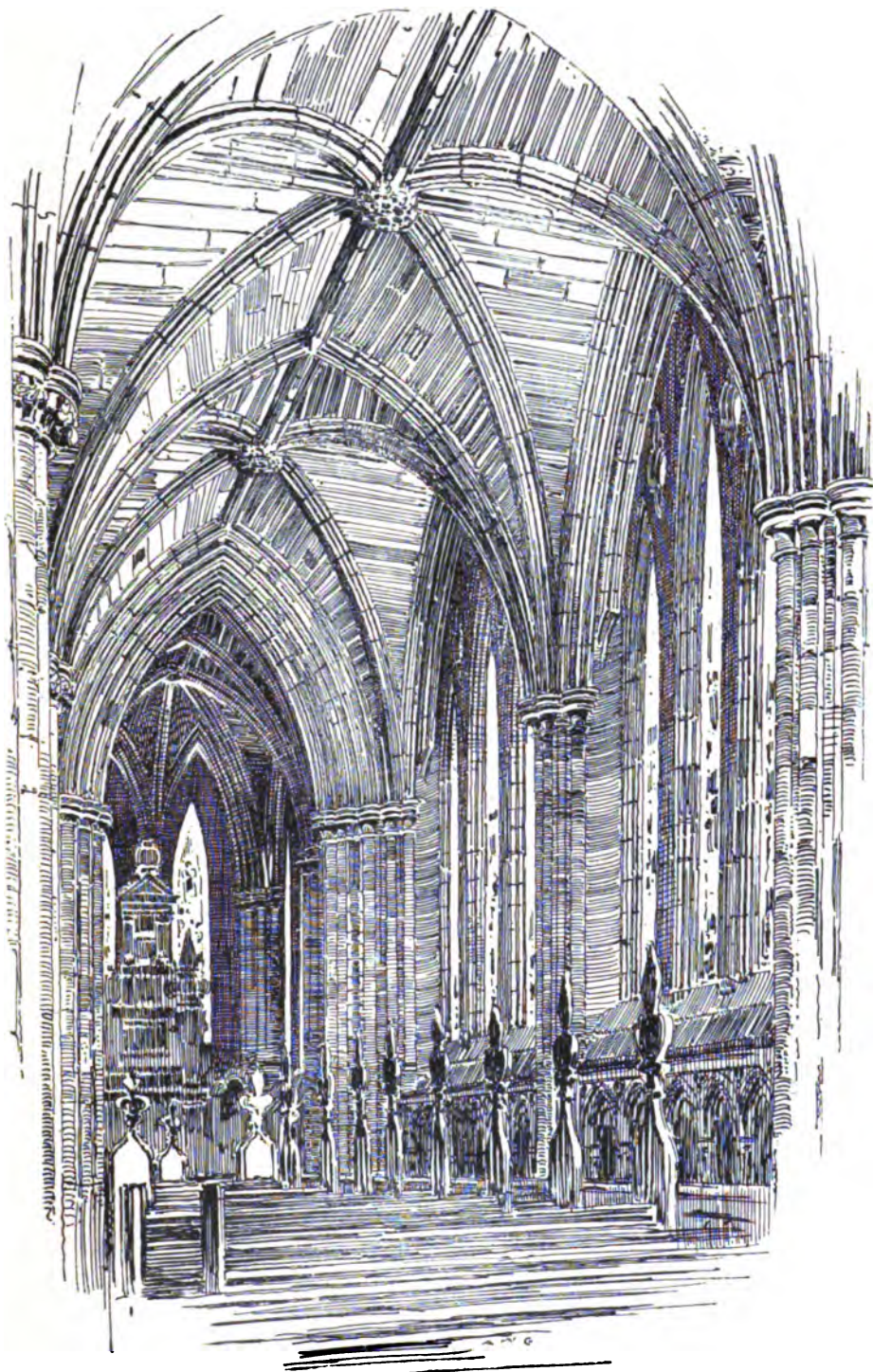


Fig. 27.

The Third Period of the Vaulting—The Choir Aisles.

main arcades and those of the eastern aisle, with the heavy arches which they carry, and the vaulting springers which belong to them had been built, and the vaulting of the north and south aisles had been completed from the transepts up to the pillars of the eastern gable. The work left over consisted of the pillars generally of the middle compartment with the vaulting which they help to carry, the vaulting of the eastern aisle and chapels, and that of the western stairs to the crypt. It is probable, as we shall see later, that a small part of the original design for the middle vault, with its requisite pillars, was actually constructed in 1240 and removed in 1260, and there is some little uncertainty with regard to certain portions of the eastern vaulting, but these and other points of detail may be left over till the work comes to be more particularly described.

Leaving the lower church in the unfinished state that we have described, Bondington pressed forward with the walls and pillars of the choir, and reached the vaulting of the upper aisles about 1250. The general design and mouldings of this part of the vaulting offer conclusive evidence not only as to the position which it occupies in the vaulting series, but also of its actual date.

It is scarcely necessary to repeat that the general scheme of the upper, as well as that of the lower, vaulting, must have been sketched out before a stone of Bondington's church was laid, that is to say about 1235. It must also have been decided by Bondington at that time, regretfully no doubt, that the choir itself, the middle area of the upper church, was not to be vaulted; so that one of the main factors in the design of the building may be said to have been the upper aisle vaulting. But the precise design and mouldings of this vault are not of that early period: they belong to the period of its actual construction, about a decade later than the lower aisle vaulting. While, therefore, the general setting out and the spacing of the pillars were arranged about 1235, the final proportions and details of the upper vault were

determined only when it came to be executed, about 1250. In modifying their original design, and introducing the mouldings then current, the builders of the later date followed the usual practice of the mediæval period.

The particular date of the construction of the upper vault is determined, as clearly as any date could be by internal evidence, of which three items may be noted—(1) The introduction of the ridge rib, (2) The moulding of the vaulting ribs, and (3) The curvature of the ribs and the design of the springers. The evidence under any one of these heads is sufficient to guide us in fixing the approximate date of the vault, but that of the mouldings narrows it down almost to a point; from them we learn further that the vaulting of the north aisle was constructed a little earlier than that of the south aisle.

The most important structural development of the vault at the time of which we are writing was the introduction of the ridge rib, and the manner in which this was brought about is sufficiently interesting to merit a few words of description. To discuss the subject with any fulness would involve much that is either too technical or too minutely historical for our pages, and it will be sufficient to indicate in a few words under what conditions this first step in the direction of increased richness and intricacy was taken.

We have described the surface vault of the Romanesque period, before the invention of rib vaulting, as a continuous arch or system of arches, and the principle on which it was constructed required that the main lines of its jointing should be parallel to the axis of each arch or vault. Where the vaults of this class intersect one another at right angles the lines of the jointing meet, also at right angles, at the groin or line of intersection of the two vaults, A, Fig. 28.

With the invention of rib vaulting the continuous arched vault disappears; the infilling between the arches assumes a new character, and is constructed in a different manner from the continuous

arch of the Romanesque vault. Each panel of the infilling is independent of the others, and is carried on the adjacent ribs instead of directly on the walls and pillars. The jointing of the panel or infilling may be carried out now in a variety of methods; it may be continued as before parallel with the axes of the intersecting vaults, and at right angles to the transverse and wall ribs,

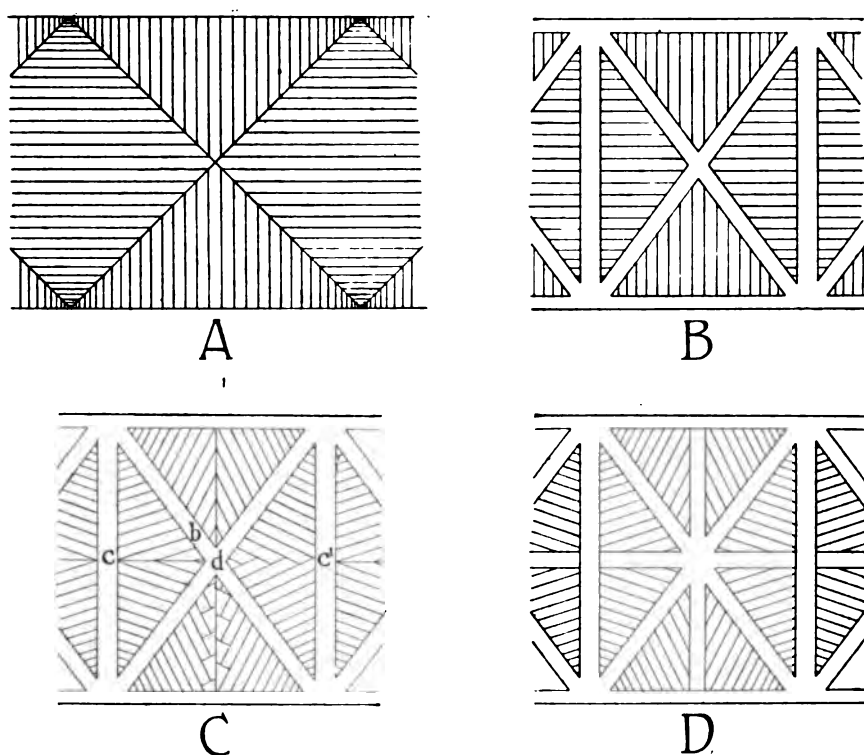


Fig. 28.

B, Fig. 28, or it may be modified as shown at C, Fig. 28. The former method is common in certain parts of France, while the latter, the method shown at C, or some variation of it, is the plan usually followed in England.

We have said that each panel of the infilling is carried on the adjacent ribs, and it may be added that it was constructed commonly without centering—the temporary wooden framework

employed in building arches and plain vaults, which was used only in the construction of the ribs. Each course of the upper infilling was bridged across from rib to rib with the assistance of an extending curved rod or baton, and as each course was finished it became a self-supporting flat segmental arch. In the arrangement shown at C, Fig. 28, however, it will be seen that there is a portion of each panel that is carried on one side only by a rib, the portion above the line $b c$; the triangle $b c d$ of the infilling meets the corresponding triangle of the opposite panel at the crown or ridge of the vault, in a serrated or straight joint from c to d or from c' to d ; the triangle $b c d$ is accordingly carried by a rib on one side only $b d$, and its construction requires a temporary support on the line $c d$; it involves some difficulty of adjustment, and is besides slightly deficient in strength.*

To obviate this objection the ridge rib was introduced, and the vault assumed the appearance shown at D, Fig. 28. Owing to the useful function which it discharges, and the improvement in appearance which it produces by binding the ribs together, the ridge rib, within a few years of its introduction, came into general employment throughout England. As it is never found in the earlier vaults, while from the moment of its introduction it is rarely absent, it may be said to mark a distinct stage in the development of rib vaulting. From this time till the introduction of the tierceron or intermediate rib the continuous or aisle vault usually consists of transverse, diagonal and wall ribs and the ridge rib. Of this character is the vaulting of the aisles and retro-choir, the upper vaulting of our choir building.

The precise date of the introduction of the ridge rib is not easy to determine, much of our vaulting being undated or not exactly dated. In the absence of any authoritative statement on the subject we can only give the result of our own limited observation, which is that up till about 1230 the ridge rib was unusual, though some

* Viollet-le-Duc, Dictionnaire de l'Architecture, Articles "Construction" and "Voute."



Fig. 29.
The South Aisle of the Choir.

1

2

earlier examples may be found, while after 1240 it is almost invariable in the more important works of English vaulting.* It is not inconsistent with these dates that the feature should appear at Glasgow between the dates of the lower and upper aisle vaulting.

The date of the upper vault is determined, however, with greater precision by the mouldings employed in the vaulting ribs. The whole series of mouldings shown at Fig. 5 is the subject of a separate chapter, but we may anticipate its contents so far as to say that the third period of the vaulting has been carried out with two sets of mouldings, the B and C mouldings of Fig. 5. The B mouldings are those which we have seen in use in the lower vaulting, while the C mouldings are of a later and richer type. These mouldings are among the most characteristic of their respective dates; each of them was widely used during a short and well-defined period, and they will be recognised by anyone at all conversant with English vaulting.

The upper vaulting witnesses the introduction of the later type of moulding and the disappearance of the earlier one, and their conjunction in a portion of the vault fixes the date of its construction more definitely than either alone could do. In the north aisle the later C mouldings are employed in the transverse ribs, and the earlier B mouldings in the diagonals, but in the south aisle transverse and diagonal ribs are all of the later variety; in the former case we see the newer mouldings introduced along with the older ones, while in the latter the earlier mouldings have been discarded altogether. The inference is, of course, that the vaulting of the north aisle was built before that of the south aisle. The C mouldings, introduced tentatively with the others in the north aisle, are employed throughout in the south aisle, while the B mouldings, now on the point of obsolescence, are definitely superseded.

The eastern work comprises an aisle of four severies connecting

*The vault of St. Hugh's Choir at Lincoln is given by Mr. E. S. Prior as c. 1195; the more usual and we think the more probable view is that it was constructed after the fall of the central tower, about 1237-1239.

the north and south aisles and a range of four chapels towards the east, the northern one serving also as an approach to the Sacristy. Owing to the heavy arches which divide the bays and chapels from one another there are no transverse or longitudinal ribs with the exception of those between the aisle and the chapels, and they are formed with the C moulding. The diagonal ribs of the ambulatory or aisle are also formed with C mouldings, while those of the narrower chapel vaults are of B mouldings. We do not, however, infer from this a difference of date in the two eastern vaults; the difference of the mouldings may be accounted for by the fact that the span of the chapel vaulting is less than that of the ambulatory, and that the designer has preferred to use the smaller moulding for the diagonals of the narrower vault, and the larger moulding for those of the wider vault. The later moulding having been introduced before the abandonment of the earlier, the two are for the moment contemporary, and the builders availed themselves of each for the purpose for which it seemed most suitable. It is different with the north and south aisles, the width of which is the same, and where the difference of the mouldings can be accounted for only by the assumption of a difference of date. We conclude, therefore, that the south aisle is a little later than the north and east vaulting; the probability is that the builders began the vaulting at the west end of the north aisle, and, continuing it round three sides of the choir, finished at the west end of the south aisle.

In a previous chapter we have referred to the fact that the second window from the transept is later in character than the other windows of the south aisle. There is some reason to believe that this section of the work may have been delayed till after the completion of the lower middle vaulting, when Walter's chapel was opened up and its vaulting rebuilt. But if so, as the upper vaulting at this point has been carried out in accordance with the general vaulting of the aisle and with the same mouldings,

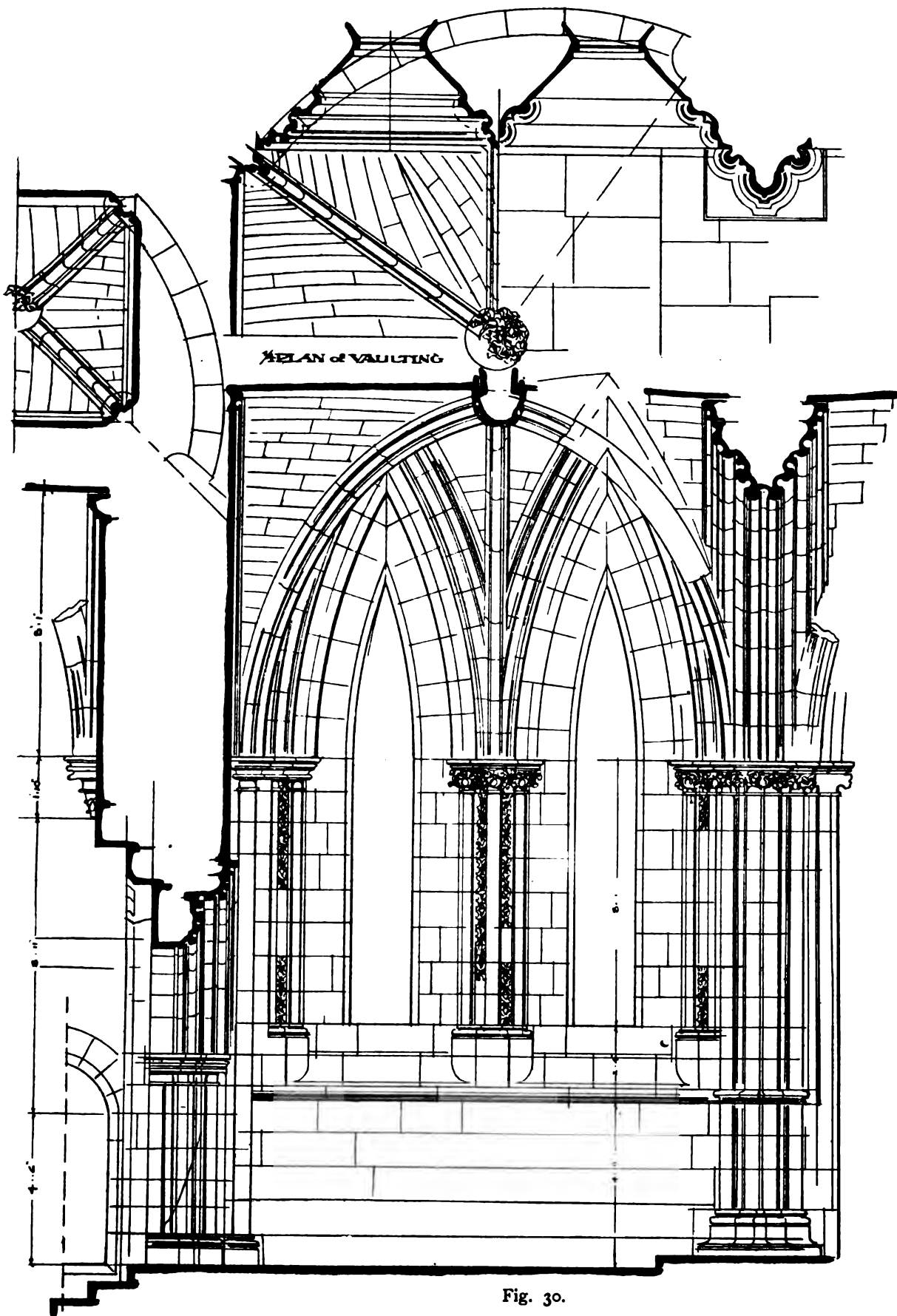


Fig. 30.

The North-East Chapel of the Choir.



Fig. 31.
The Eastern Chapels of the Choir.

its design is of the same period, whether it was actually executed at this time or a few years later. It is conceivable also that other portions of the vault may have been delayed; they may have been taken down and re-erected, or they may have been injured and repaired at some time subsequent to their construction. Owing to the continued movement of the side walls, repairs have been required from time to time down to our own day. If, however, it could be shown that one part of the vault had been delayed, or that another part had been taken down and rebuilt, such a fact would not affect the general question of the date of the vaulting. Its design would still be rightly described as of 1250, just as that of Walter's vault is described as of 1220, though rebuilt about forty years later.

If we suppose even that the aisle vaulting had been delayed till after the construction of the clerestory walls, its date might still be reckoned from the time of the formation of its springers. In the case of the eastern vaulting of the lower church, to be described in Chapter VII., we have work designed originally in 1235-1240, and with springers of that date, but delayed otherwise till the period of the E mouldings. We have classed this with our fifth period, because springers and mouldings of the later date have been introduced among the earlier ones. But the upper vault must be described as of the period of its springers, whether its completion was delayed for a few years or not. The design and mouldings are of that date, and have not been subsequently modified. The great probability is, however, that, following the usual practice of the period, the vaulting of the aisles generally was completed along with the walls and springers that pertain to it.

The diagonal ribs of the north and south choir aisles, owing to the width of the bays, are still nearly semi-circular, while those of the eastern chapels are slightly pointed; in each case, of course, the other vaulting arches are more acutely pointed. The general proportions must have followed to some extent the original design

of 1235, the setting out of the pillars and the span of all the arches having been determined at that date. The details of the work, however, are of 1250, and they are markedly later than those of the lower aisles, the mouldings being more developed and the springers more skilfully composed (figs. 27 and 29 to 31). The ribs of the north and south aisles have been dislocated at parts by the unfortunate bulging of the side walls; making allowance for this, the vault is a good example of its period, while that of the eastern chapels (figs. 30 and 31), which is not subject to this defect, is of the most graceful proportions.

The simpler variety of the ribbed vault was brought to its greatest perfection at this time; the mouldings were richer and the springers more skilfully designed than at any other period. In pure beauty of line and shadow it is difficult to conceive of vaulting finer than that of the middle of the 13th century—henceforth its development was to lie in the direction of increased variety and richness.

The aisle and eastern vaulting, with the triforium and clerestory walls and the wooden roofs, having been completed, the building was now closed against the elements, and the designer was able to turn his attention once more to the lower vault, the interesting and beautiful middle compartment of which, the fourth stage of our vaulting, is the subject of the following chapter.





Fig. 32.

The Fourth Period of the Vaulting—The Middle Compartment.

Chapter VI.

The Fourth Period of the Vaulting, the Middle Compartment of the Lower Church. Date circa 1260. C and D Mouldings, and, in connection with the original Springers, B Mouldings, Fig. 5.

THE middle compartment of the lower church, the fourth stage of our vaulting, is the most interesting, and perhaps also the most beautiful, feature of the Cathedral. It is a very moderate appreciation to call the interior of which it forms part "the finest crypt in Europe," because, as we have seen, most of the crypts of Europe belong to a period before the pointed style of architecture had come into existence, and when the vault was still rude and primitive. But the crypt or lower church of Glasgow Cathedral occupies a not undistinguished position among the buildings of its own period, when the art of vaulting, and the architecture to which it had given birth, were approaching, if they had not already attained, their greatest perfection.

While the middle compartment comprises the most notable section of the vaulting, there is no detail of its design or construction that does not find a parallel in the period to which it belongs. It is indeed typical of its own period so far as the parts of which it is composed are concerned. Its particular claim upon our attention lies rather in the original and happy combination of well-known features, and in the fact that the present arrangement of its vaulting was substituted for a partially executed plan—that it is in fact a new design ingeniously and successfully engrafted upon an older one.

At the period of the lower aisles, when the earlier design for the middle vault was prepared, the art of vaulting with arched ribs was still immature. The vaulting plans were simple and the ribs few, comprising no more than transverse, diagonal, and wall ribs; their mouldings were massive and simple rather than rich, and usually rounded on the under side. At this period the existing design of the middle vault was impossible—it was impossible at all events at Glasgow—quite as much as it would have been a thousand years earlier. The interval, it is true, is one of twenty years only, but till that interval had been passed, till the successive steps which occupied it had been taken, the middle vaulting as we see it to-day could not have been produced.

The construction of this, the fourth section of the vault, must have been reached either immediately before or soon after the death of Bishop Bondington in 1258. The change of design may have been wholly ecclesiastical in its origin, or it may have been partly architectural. In either case we may assume it to have been the subject of conference between the authorities of the church and their architect, and it requires no effort of imagination to picture the latter debating the several courses open to him. The original plan of the middle vaulting, his own plan probably, is in his hand, and round him are the springer stones of all the outer pillars and of the western wall, a considerable part of the early plan already carried into execution. It may be, as we have said, and as we shall see later, that more than the springer stones had been carried out, that some of the inner pillars of the old plan had been built and a few of the vaulting ribs and panels thrown between them. A natural and obvious course would have been to carry on to completion the work that had been begun twenty years before. There was every inducement to follow at least the general lines of the early plan, varying only the mouldings and other details where that could be done conveniently; in ordinary circumstances perhaps no alternative course would have been considered.

In the present case it is probable that a certain alteration in the arrangement of the pillars of the middle area was desired by the authorities of the church, while the architect on his part was not unwilling to discard the design, already obsolete, of an earlier period. A new design was made and carried out in spite of the fact that it involved the alteration or renewal of most of the original springers, 25 in number, that surround the compartment.

We defer the detailed examination of the springers till the chapters on the early plan, and confine ourselves here to the design of the existing middle compartment and the stage of development which the art of vaulting had reached at the period of its inception. The plan may be described as belonging to the type evolved in the vaulting of isolated compartments such as chapels, central towers, and particularly the chapter-houses, square, oblong, and polygonal, of the middle of the 13th century. These last are among the most striking and beautiful features of our cathedrals, and their influence upon the vault was most marked, tending towards the development of the star-like arrangement of ribs characteristic of the later phases of vaulting, while the considerable size of many of the chapter-houses may be supposed to have contributed to the enrichment of the vaulting plan by the multiplication of the vaulting ribs.

Among the simpler and earlier forms of the chapter-house vault is the one square on plan and having a central pillar, with the vaulting divided into four ordinary square compartments. In the Chapter House and Sacristy at Glasgow (fig. 2) we have the application of the same principle to a square each side of which is divided into four compartments instead of two, the Chapter House being without the ridge rib while the Sacristy possesses it, while both apartments have the central column.*

In most of the earlier chapter-houses we find this feature of the central column supporting the vaulting, but after a time it was

* The Sacristy and a portion of the Chapter House are of late date, but the plan of their vaulting has been dictated in some measure by the earlier part of the work.

found possible to dispense with it by the introduction of a piece of flat domical vaulting in place of the part of the vault that otherwise would have been carried by this pillar. At the west end of Lincoln Cathedral, on the north and south sides of the nave, there are two chapels (fig. 33), the Morning Prayer Chapel and the Consistory Court, which well illustrate this change, and, as Sir Gilbert Scott has pointed out, correspond in principle with the two large square divisions on the one hand, and the oblong eastern division on the other, of the middle vault at Glasgow. We cannot do better than quote his description both of the Lincoln and the Glasgow vaulting.

"The two chapels" (at Lincoln) "are alike in plan—an oblong each side of which is divided into two arches. They only differ in that one has a central pillar and the other has none. The one" (A, fig. 33) "is simply divided into four groined vaults on the most customary principle. The other" (B, fig. 33) "is similarly vaulted up to the line of the square, the angles of which would be

represented by the four bosses of the first-named vaults; but from thence the diagonal ribs, instead of returning downwards on to a central pillar, continue to rise till they meet in the middle point of the chapel. This upper portion, therefore, is the top of a square dome; and the whole vault may be described as a square dome

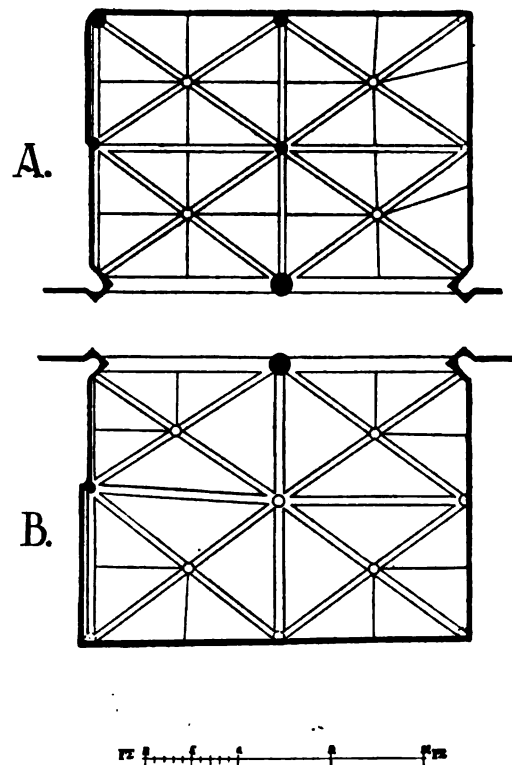


Fig. 33.

The Western Chapels at Lincoln.

penetrated on each side by two Welsh groined cross vaults. This combination is common in the vaulting under central towers, as at Lincoln and York; though in these cases the central portion is bounded by a strongly-marked horizontal line defining the boundary of the half groins below and the square dome above. In the chapel I have been describing there is no such boundary-line, but the groining compartments continue till they meet in a point at the top. This system may be carried out with any number of bays; and we have in the Chapter House at York an instance of its application to the octagon. The plan of the vaulting there is identical (or nearly so) with that of Westminster or Salisbury, but the portion enclosed within the inner octagon, instead of turning down to the central pillar, runs up to the point at which all the arched lines would meet in the centre.

"The relation between the vaulting of the Chapter Houses of York and Westminster is, in fact, just the same as that between the two chapels at Lincoln just described. In each case we see how similar forms may be covered over with vaulting nearly identical in plan—with or without a central pillar at pleasure.

"There is a parallel case in the crypt at Glasgow Cathedral, in which the compartment is divided on three of its sides into *two* and on the other into *three* arches. This crypt is a work in which the architect would appear to have revelled in self sought perplexities, and to have solved them, one after another, with singular success. The portion of the crypt which represents the choir overhead is really one of the most lively and amusing pieces of vaulting I know. It consists of *ten* bays, and as the east end is necessarily divided into *two* bays, for the support of those above, nothing would have been more natural than to have placed an intermediate row of columns down the centre, dividing the whole into two ordinary ranges of vaulting. But no, the architect would have lost his fun by any such commonplace scheme, and *we* should have lost a very pretty and instructive puzzle.

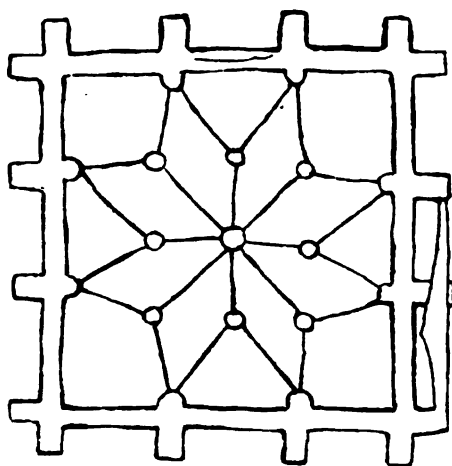
"Beginning at the east end, he first cut off a space two bays long, then a second of three bays long, then a single bay, then another space of three bays, and finally a single bay at the west end; while to each of his groups of three bays he gave a central column, and repeated the three-fold division on its east and west sides. These square spaces, then, each of whose sides is divided into three, became the keynote of his scheme, and most ingeniously and beautifully he vaulted them. The principle followed is really, however, nothing more than an adaptation of the ordinary mode of dividing a square into four smaller squares of groining, to a space whose sides are divided into *three* instead of *two*. The central square resting on the column remains unaltered, but the sides have each *three* cells, the transverse ribs from the central column being bifurcated at their apices, and instead of going across to an opposite pillar spread right and left to the *two* pillars, while the main diagonal ribs remain unaltered. These are met at their apices by half-diagonals coming obliquely from the same pillars in the sides. The result is a star-like arrangement of an exceedingly pleasing, though at first sight intricate, character.

"Adjoining one of these beautiful squares comes the compartment first alluded to. It is a very parallel case to that last described. On three sides it is the same as the Lincoln chapel, with a portion of a square dome instead of a central column, while the fourth side, having *three* divisions instead of two, is dealt with precisely as has been described in the preceding case. Amongst these intricate compartments are alternated single bays, each divided transversely into three squares of ordinary groining; and the perplexity of the effect of the crypt arises not so much from the difficulty of any of the forms of vaulting, as from the constant change from one form to another, no two adjoining divisions being alike. The whole is carried out with excellent detail, and forms a most beautiful and interesting interior."*

* Lectures on Mediæval Architecture. Sir Gilbert Scott. London, John Murray, 1879.

It is of interest to note that the two chapels at the west end of Lincoln Cathedral were probably built by Robert Grosseteste, one of the most eminent churchmen of his day, whose tenure of the See at Lincoln (1235-1253) synchronises with that of Bondington at Glasgow (1233-1258). The work of Grosseteste at Lincoln shows throughout a close correspondence in points of detail with that of Bondington at Glasgow.*

In the National Library at Paris there is preserved a work of extraordinary interest to which we have already referred,† the



Pa chn mer orn on capital durt wlon
bet a ote sole sen nest uet h en oon
bret set h machonerie bone

Fig. 34.

Vilars' plan of Vault.

original sketch-book of a French architect of the 13th century, Vilars de Honecort, the designer, there is reason to believe, of the choir of Cambrai Cathedral, now destroyed, and of important work in Hungary.‡ The book contains, as might be expected, many drawings illustrative of problems of vaulting, with plans of vaulted buildings; among others there is a sketch, which we reproduce at Fig. 34, of an apartment the vault of which is almost

identical with the squares of three arches on each side in the middle compartment at Glasgow. The legend attached to the drawing is

* The resemblance of the south-east porch at Glasgow and the side doors of the west front at Lincoln has been pointed out by the late Mr. W. J. Anderson, A.R.I.B.A., Transactions R.I.B.A., 15th October, 1898. Other points of similarity in the work of the respective prelates might be noted.

† Page 24, *ante*.

‡ Published in facsimile, and edited by Willis: T. H. & J. Parker, London, 1859.

to the following effect, "Thus the capitals of eight shafts are connected with one central one. This is good masonry."*†

In his description of the sketch Willis says "The plan represents an isolated square chamber having two vaulting shafts against each wall, and a buttress corresponding to each on the outside. In the centre of the chamber is a shaft in the manner of a chapter-house. The eight lesser circles in the intermediate space represent the bosses of the vault, and the lines connecting these with the shafts are the vault-ribs.

"The only part of the plan which is not quite intelligible is the mode of vaulting the compartment at each angle, which is in the form of an irregular quadrilateral. Lassus observes, that as the two sides of this compartment which belong to the external wall must have had wall-ribs in the form of an arch, and as the lines which form the other sides of the compartment are semi-arches springing from the wall to meet in the boss, it follows that another rib is wanting, which, springing from the corner of the apartment and rising to the same boss, should divide this compartment diagonally. . . . I think it probable, however, that Honecort intended to vault the compartment in question with three vaulting surfaces, one of which would rest upon the two neighbouring wall-ribs that spring together from the corner of the chamber, and each of the two others extend from one of the vault-ribs to its neighbouring wall-rib."

It will be noted that the only point of difference between Vilars' vault and that of the square divisions at Glasgow is the absence of the outer half of each of the diagonal arches, which Lassus, the French editor of Vilars, considers an oversight, but which Willis thinks has been left out by design. Most curiously Viollet-le-Duc‡

* Pa chu met om on capitel duit colonbes a one sol. sen nest mies si en conbres. sest li machonerie bone.

† The lines crossing one of the buttresses on the right belong to another figure.

‡ Dictionnaire d l'Architecture, Vol. VIII., p. 95.

inserts the four angle ribs or half diagonals in his sketch, probably from memory, of Vilars' plan, without referring to the fact of their absence from the original, and at the same time censures Lassus for having added certain other ribs in a plan which does not profess to represent that of Vilars but another vault altogether, referred to in illustration of it.

Viollet-le-Duc analyses briefly the construction of his own version of Vilars' sketch, which is precisely the Glasgow arrangement, and adds that it is on the principle (*c'est la donnée*) of the English chapter-houses reduced to the square form. To this we may add, as Sir Gilbert Scott suggests, that while the two square figures of the middle compartment at Glasgow recall the vault of the polygonal chapter-houses which have a central pillar, the oblong division, under the high altar, follows the idea of those that, like York and Southwell, have no pillar, but a flat domical vault, in the middle of the apartment.

There is no date attached to the sketch-book of Vilars, but this is sufficiently determined by its contents. M. Quicherat, Professor of Archæology at the Ecole des Chartes of Paris in 1849, has shown that one of the drawings in the book must have been made between 1243 and 1251, that Vilars' journey to Hungary was undertaken between 1244 and 1247, and that the book was probably completed and the memoranda added on his return. The French and English editors agree with these conclusions. Vilars' note and sketch imply that some degree of novelty attached to the idea of the vault, and it is not unreasonable to suppose that they may have preceded the construction of the corresponding vault at Glasgow by a few years.

Vilars' plan shows an octagonal vault applied to a square apartment; it may be described as a somewhat novel application of well-known methods rather than as a new method of vaulting, but the idea was one that found its chief development in the English polygonal chapter-houses, several of which were founded about

1250. From that time onward the polygonal or stellar type of vault is exceedingly common, and its persistence, subject to an infinite variety of treatment, may be accounted for by the inherent beauty of the form and the facility with which it adapts itself to every exigency of the plan. In its later developments, and in the fan vaulting of the 15th century, the star-like form assumes a dazzling intricacy, and it continues in use till the close of the mediæval period;

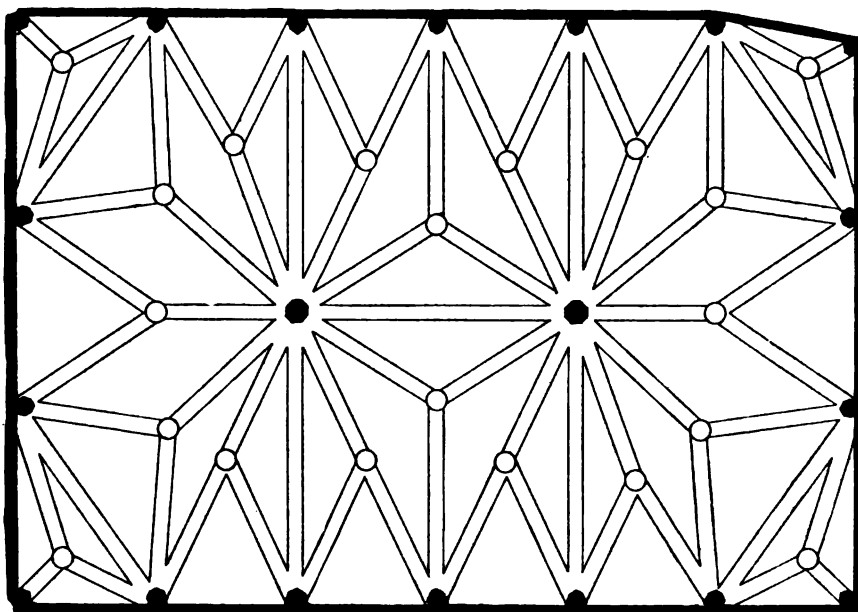


Fig. 35.

Briefcapelle, Marienkirche, Lübeck.

it continues even into the period of the Renaissance, when so many Gothic traditions were maintained for a time under a slightly different garb.*

Two very interesting variations upon the type of Vilars' sketch and the Glasgow plan may be seen at Lübeck in North Germany, and date from the 14th century. The earlier one, of about 1310, is the vault of the Briefcapelle attached to the Marienkirche of that

* A characteristic example of the middle of the 16th century is found in Saint Florentin (Yonne). Viollet-le-Duc, *Dictionnaire de l'Architecture*, Vol. IX., pages 544 to 548.

town. The chapel is roughly about 40 by 30 feet—about the same width, that is, as the middle vault at Glasgow; it is, however, much loftier than our crypt. The side walls are divided into six, and the ends into three, bays, so that the divisions of the ends are wider than those of the sides. The vault (fig. 35) is supported on two slender columns, each of which is the centre of a star-like figure of nine points, the portion of the vaulting between the pillars being

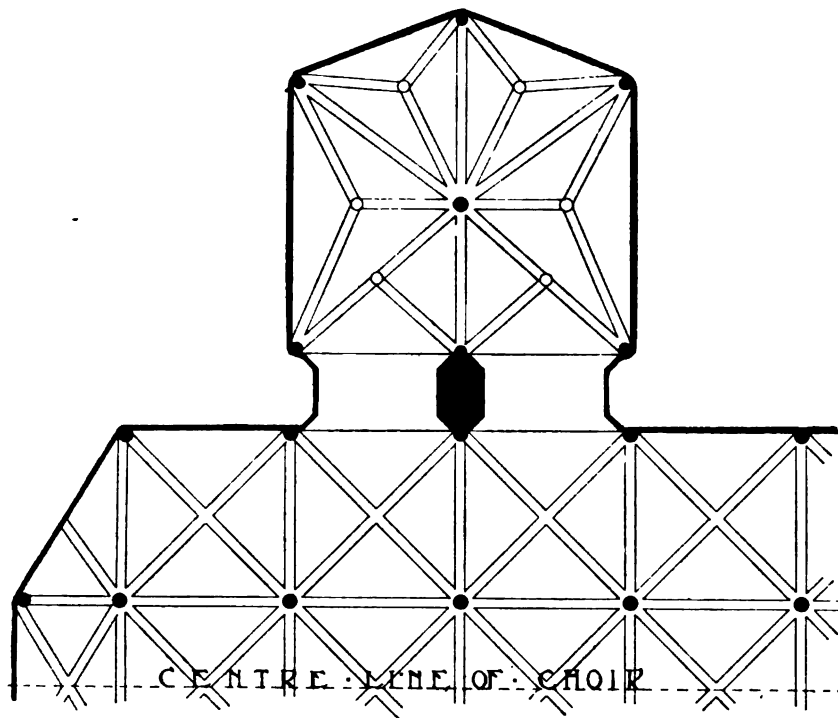


Fig. 36.

Chapel, Saint Catharine's Church, Lübeck.

common to both figures, and several of the rays being divided by a rib in the middle. The outline of the chapel, though rectangular in form with a slight obliquity at one corner, is converted into an irregular octagon by cutting off the angles with arched ribs, so that the general outline bears some resemblance to that of the Chapter House at Lichfield, also an irregular octagon, but vaulted with one pillar instead of two.

The other example is from the church of Saint Catharine, Lübeck,* said to be of the middle of the 14th century. This church possesses an elevated choir carried on columns, and our sketch (fig. 36) shows the plan beneath the upper choir and on the level of the nave and lower choir. On the south side of the latter, and opening into it with two arches, there is a small pentagonal apartment or chapel with a central pillar from which ten ribs spring. Five of these go to the angles of the pentagon and a sixth to the pier between the arches opening into the lower choir. The other four ribs are half arches terminating in bosses, where they are met by the bifurcating ribs which spring from the angle wall shafts. Although the apartment is pentagonal the vault forms a figure having six rays or points, one of the five sides being divided into two owing to the occurrence of the double arched opening into the church. It will be noted that the vault on this side has been skilfully adapted to the double opening, a pair of ribs and a boss having been arranged opposite each of the two arches, although this involved the omission of certain of the ribs and some consequent irregularity in the star-shaped figure, an irregularity, however, more symmetrical in effect than perfect symmetry would have been.

We shall have occasion to refer to the mouldings of the middle vault in a subsequent part of this work, and content ourselves at present with a word as to their character and general distribution. They are of three varieties (B, C, and D, fig. 5), and of three dates. The B mouldings are of the period of the lower aisles; the C mouldings, as we have seen, were introduced at the period of the upper aisles; while the D mouldings are now introduced for the first time. At the date of the middle vault the B mouldings were obsolete, the C mouldings were still current, and the D mouldings were new. In view of these facts, it is interesting to note the disposition of the mouldings as shown on Fig. 6.

* This is a simple and beautiful brick structure of commanding proportions. The difficulties of adapting the building to a very irregular site have been met with great originality and success. It is to be regretted that this fine church should have been diverted to secular uses.

The B mouldings (coloured purple on the plan) are those employed in the adjacent aisles, the 25 outer springers of the middle vault having been constructed at the same time as the aisle vaulting and with the same mouldings. Hence we find a considerable number of ribs of B section, in all cases rising from, or immediately connected with, the outer springers. Obviously they owe their existence to the springers of 1240, which the designer of the vault of 1260 utilised as far as it was possible for him to do so. They form a slightly irregular fringe round the outer margin of the vault, and tell their story with a directness that one would suppose could not be misunderstood. The C mouldings (coloured red) radiate, for the most part, from the central pillars of the two large square figures of the vault, while the D mouldings (orange colour on the plan) are found in all the ribs springing from the four pillars of the shrine and those on the opposite sides of the two large squares, and they predominate also in the eastern oblong section of the vault—the portion beneath the high altar. The C and D mouldings also tell their story with sufficient clearness, and, in conjunction with the general design of the vault, define the period of its construction with great precision.



Chapter VII.

The Fifth Period of the Vaulting, the Vault over the Transeptal Stair, the Eastern Aisle and Chapels of the Lower Church. Date uncertain, but not earlier than 1270. E Mouldings and, in connection with the original Springers of the Eastern Vault, B Mouldings, Fig. 5.

WE have followed the progress of vaulting as far as the introduction of the ridge rib and the development of the polygonal vault with its star-like arrangement of ribs.

After the ridge rib had been in use for a number of years, it was found that some additional support was required for it in the larger vaults. Where the distance from the intersection of the diagonals and the transverse or wall rib was considerable, the ridge rib, in English vaulting usually level or nearly so, was liable to dislocation on any slight movement of the building, the stones drooping in the middle and the joints opening, a defect only too well illustrated in the aisles of the choir. The panels also, where they exceed a certain width, seem to call for additional support between the diagonal and transverse ribs and the diagonal and wall ribs. The necessity for a further vault rib to support the ridge and help to carry the infilling was soon proved, and we find accordingly that the next step in the development of the vault was the introduction of a new rib between the diagonal and wall ribs. This new rib is

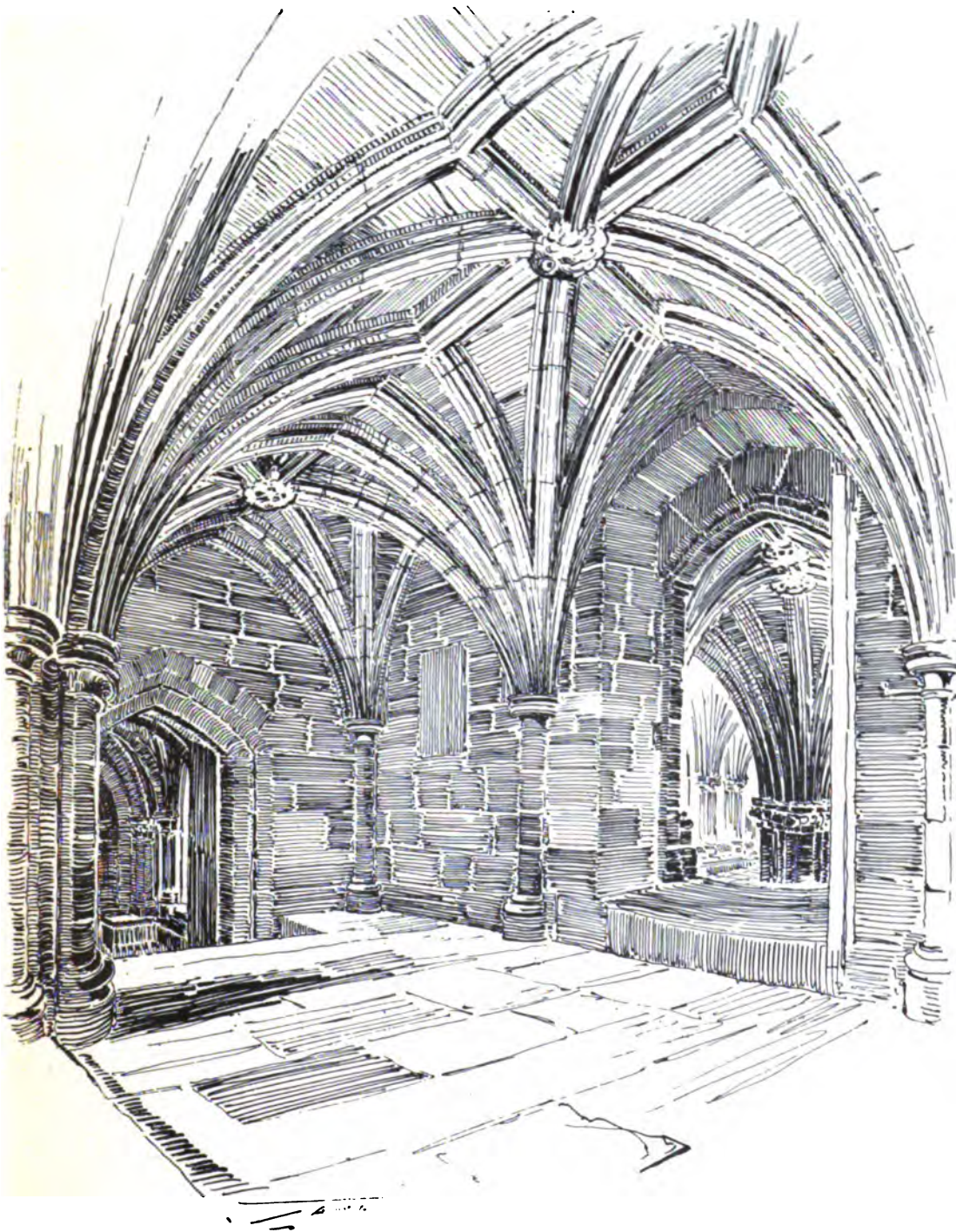


Fig. 37.

The Fifth Period of the Vaulting—The Transeptal Stair.

called the tierceron in French, but, although characteristic of English rather than of French vaulting, it is without other name in our own language.

Among the largest vaults of this period the English chapter-houses are conspicuous. Several of these, dating from the middle of the 13th century, measure about 60 feet in diameter, and it is a

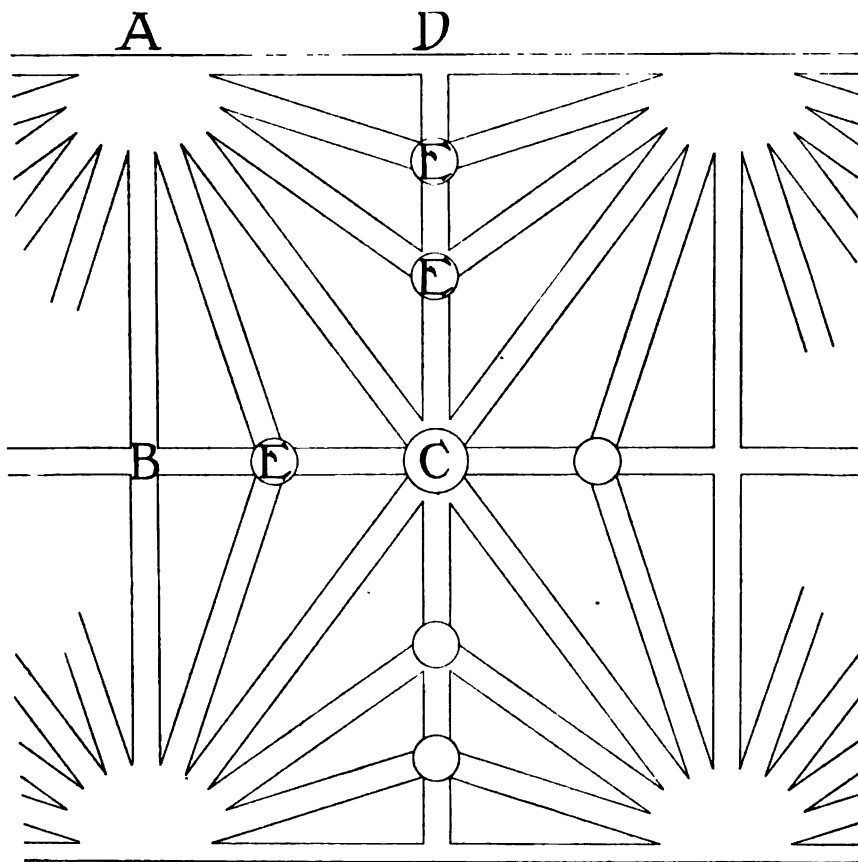


Fig. 38.

Tierceron Vault.

fair inference that they exercised some influence in the development of the tierceron as well as of the polygonal or stellar vault. From the period of the adoption of the tierceron this rib is rarely absent from the larger vaults in England, and in a short time it found its

way into those even of the smallest dimensions, where of course no constructive necessity for it exists. Originating, like other architectural features, in the requirements of construction, it soon becomes a motive of decoration and an important factor in the future development of the vault. The next step is the introduction of a second and sometimes a third intermediate rib between the diagonal and the transverse or wall rib. It would carry us too far from our subject to trace the consequences of the introduction of the tierceron; it must suffice to say that it immediately affected the curvature and the moulding of the vaulting ribs and the composition of the springer. Even within the period of the rib vault we may recognise in the multiplication of members and the resulting changes in the composition of the springer the tendency which led ultimately in England to the development of the four-centred or Tudor arch and the fan vaulting of the 15th century.

Fig. 38 is a diagram showing a compartment of vaulting with one tierceron between the diagonal and transverse ribs and two between the diagonal and wall ribs. A B is the transverse rib, A C the diagonal, and A D the wall rib; the three tiercerons are marked A E, and they reinforce and support the ridge ribs B C, D C. At the same time they help to carry the infilling of the vault, sub-dividing the spaces A B C and A C D into two and three panels respectively. The arrangement shown is very common in England during the latter half of the 13th century.

The tierceron appears at Glasgow in the aisle of Fergus, the southern crypt,* which, however, is beyond the scope of our inquiry, and in the vaults over the transeptal stairs leading from under the central tower to the west end of the crypt.† These latter small vaults are of a type which seems to have originated in the third quarter of the 13th century, and to have continued in use for a lengthened period. The plan is shown in Fig. 39, and it will be seen that it possesses one tierceron in each of the spaces between

* Fig. 15.

† Figs. 37 and 39.

the diagonals and the transverse and wall ribs. The peculiarity of this type of vault, however, lies in the fact that the ridge rib is discontinued from the point where it encounters each pair of tiercerons. The interrupted ridges which thus separate the four rays of the star are called *liernes* by French authorities, while the few English writers on the subject, following Willis, apply this term to another rib now to be described.

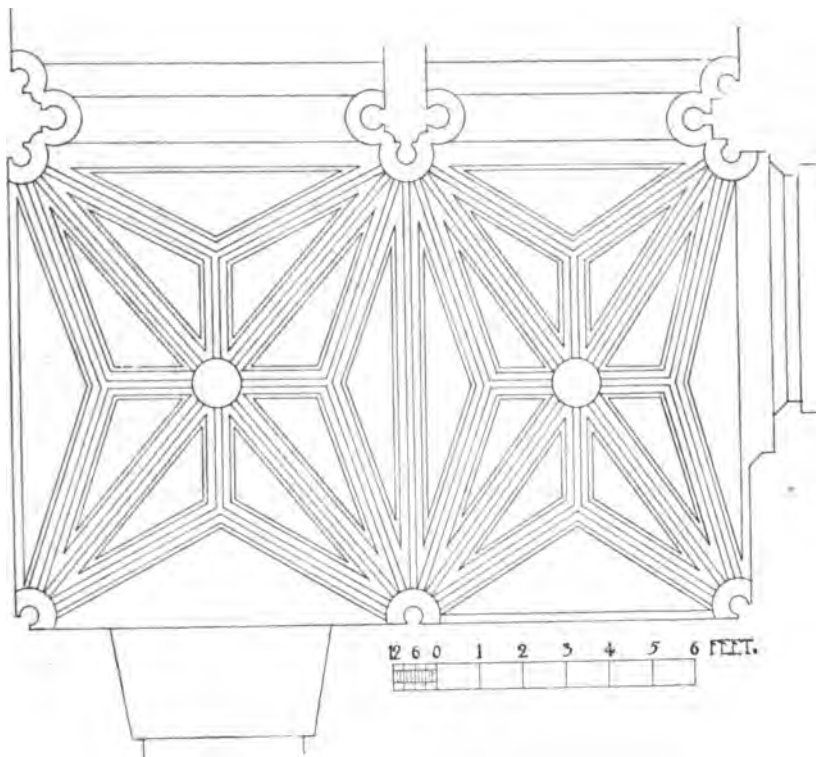


Fig. 39.

Vault of Transeptal Stair.

The use of the tierceron and the continued increase in the number of the ribs led to the crowding of the springer, and consequently to the diminution in width of the vaulting ribs, and particularly of the lower member of the rib moulding, the one which alone appears in the lower part of the springer. This attenuation of the moulding diminishes the lateral strength, both actual and

apparent, of the ribs, and some support is required to stay or stiffen them between the springing and the crown of the vault; with this object the vault is further enriched by the introduction of short cross pieces between the main ribs. With a view to the development of the star-shaped figure, the cross ribs are frequently arranged obliquely or diagonally with reference to the main ribs, the result being that the plan of the vault is that of a star within a star. These short intermediate ribs are called *liernes* by Willis and *contre-liernes* or *goussets* by French architectural writers.* In the diagram Fig. 40, which represents the vault of Queen's College gateway at Cambridge,†

M and N are *liernes* in French, while the other short ribs are *contre-liernes* or *goussets*; in English nomenclature M and N are ridge ribs, while the other short ribs, A B, B C, C D, D E, are *liernes*.

The *lierne* rib, in the English sense, does not occur at Glasgow; according to the French acceptance it is found

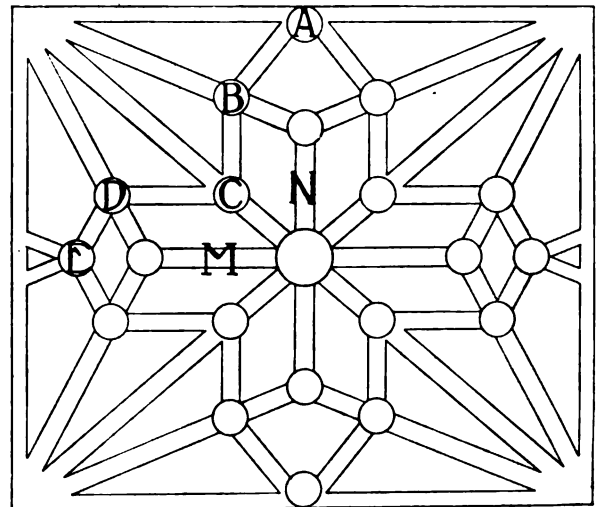


Fig. 40.
Lierne Vault.

in the vaulting over the transeptal stairs to the lower church, Fig. 39.

It would be interesting to trace the consequences of the introduction and multiplication of the tierceron and *lierne* ribs, but the subject would take us too far from the Cathedral of Glasgow,

* Philibert de l'Orme, a writer who lived at the beginning of the period of the Renaissance, refers only to the truncated ridge ribs, which he calls *liernes*, and is followed in this by modern French writers. Willis believes the same term to have been applied during the middle ages to the short intermediate ribs which go neither to the springer nor to the ridge of the vault, and uses it accordingly in this sense. The word is also a term of carpentry.

† From Willis, Transactions R.I.B.A., 1842.

and indeed from Scottish architecture generally, which from this point pursues an independent and somewhat erratic course. There is little to be found in Scotland that resembles the intricate lierne vaulting, still less the fan vaulting, of England. The 14th and 15th centuries have their own interest in Scottish architecture, but we do not find the same logical and consistent development that we see in France and England; with some notable exceptions, the style is rather reminiscent of earlier efforts than ambitious of further achievement in the direction of vaulting.

In the stair vault, Figs. 37 and 39, we have a design which could not, we think, have been produced earlier than 1270, but which is probably somewhat later. The type is one which appears in France, and more frequently in England, at this period, while the mouldings are apparently even later in character. As we approach the close of the century the dates in Scottish architecture become more uncertain. The clear path of the development of the vault in England is no longer closely followed. It is plain, however, that the design and mouldings of the stair vault are markedly later than those of the middle compartment—how much later exactly we are not prepared to say.

Turning now to the opposite end of the lower church, to the eastern aisle and chapels, we find a vault totally unlike those of the two western stairs, but there is reason to believe that its construction belongs to about the same period. Its general design resembles that of the north and south aisles, and about one-half of the rib mouldings are of the same class, the remainder being of the later type that we find in the stair vaults.

The eastern vaulting of the lower church (*see* fig. 6) consists of eight bays or severies, four of which belong to the eastern aisle and four to the chapels. The vaulting of the aisle is carried out mainly with the early moulding, while in that of the chapels the late moulding predominates. At first sight one might be excused for supposing the eastern aisle vaulting to be of the same date as that

of the north and south aisles, with some later additions or alterations at each end. A little consideration, however, will show that the whole vault, with the exception of some of the springers, is of later date as to construction, though, in fact, its design is that of the earlier period. The eastern aisle and chapels form the continuation and termination of the north and south aisles, and, as continuity of design is almost of the essence of an aisle vault, we can understand why the original design should have been adhered to in the later part of the work. But, besides this, many of the springer stones had already been formed at the early period, and, of course, with the early mouldings and in accordance with the early plan. As in the case of the Norwich cloister, the original and partly executed design was carried on to completion at the later date without any important modification. There are several indications of date in the construction and details of the work, but the indisputable proof of its lateness at each end of the aisle and in the eastern chapels is the fact that vaulting ribs of the E section appear among those of the early moulding.

The eastern aisle has been carried out for the most part with the B1 moulding, the only exceptions being the axial rib which springs from the middle of the two-light window at each end, and the diagonal rib of the south-east corner, which are of the E2 section. The eastern chapels, on the other hand, are carried out with the E2 moulding throughout, with the exception of the four diagonal ribs of the northmost chapel. The only transverse ribs, apart from heavy arches, are those which divide the chapels from the aisle, and they are of the E1 section.

We have thus an early vaulting plan carried out at a later period with a mixture of early and late mouldings. At this time the B mouldings were long out of date and could only have been employed under the constraint of the springer stones, or other work of early date, which it was desired to retain; when this constraint was removed, the builders immediately reverted to the mouldings in current use—that is, in the present case, to the E mouldings.

In the continuation of an unfinished building it was not infrequently necessary to employ the earlier mouldings in work executed in the later period, and this not only in the vaulting ribs but in other parts of the building also. If we suppose, for example, the work to have been left off at one side of a window or other arched opening, when the other side of the opening comes to be built and the arch itself completed the builder must conform to the details of the work already done unless he is prepared to pull down and rebuild a considerable part of this existing work. He must, in most cases, build his side of the opening like the other side, and the arch which covers it must conform to the portion on one side which has been already built. But if a new feature of any kind has to be introduced on the side last built, most probably the designer will follow his own methods, and we shall have earlier and later mouldings mingled in the later part of the work.

We assume now the case of a coupled or two-light window of which the pier and arches were delayed for a considerable term of years. The outer sides of the double window, with the springing of the arches, have been formed at the early period, and, of course, with the early mouldings. When the middle pier comes to be built and the arches thrown over the windows, the builder naturally continues or repeats the early mouldings both of the jamb and arches. If, however, we suppose that the middle pier of the window has to carry a vaulting rib, the designer will probably seize the opportunity to introduce a moulding of his own period; he may also make the capital of his middle pier different from the early capitals of the jambs. We shall then have a late capital carrying a late vaulting rib, but with early arch and jamb mouldings on each side, all, of course, wrought and built together. This is exactly what we find in the two-light windows at each end of the eastern aisle. A late vaulting rib (E2, fig. 5) springs from the pier in the middle of each of these windows. The window at the north end (fig. 41) is flanked with diagonals of the early section B1, while

the one at the south end has an early moulding in the diagonal on one side and a late moulding in that of the other. In both cases the jambs and arches of the windows are of the early character, but the capital and corbel of the middle pier, like the vaulting rib which they carry, are of a different and later type. The springer of the middle pier, as shown by Fig. 41, is of some interest. The earlier arch moulding and the later rib moulding do not enter into combination with one another, but, like oil and water, refuse to mingle. They do not develop out of one another in rising, as we expect the mouldings of a properly designed springer to do; the mouldings of the outer window arch (the inner arch with reference to the wall) do not appear at all at the level of the abacus, while those of the vaulting rib, in place of merging in the other mouldings, remain entire and occupy the whole area of the corbelled capital. It is not an unconstrained springer of either period, but shows the somewhat awkward encounter of mouldings that have nothing in common.

It is perfectly obvious, we think, that the early arch moulding is due to one or both of the outer jambs of the double window having been built at the early period, the period of the B mouldings, while the late moulding of the middle vaulting rib



Fig. 41.

Two-light Window of Lower Eastern Aisle.

shows that the pier between the windows was delayed till the period of the E mouldings. The window arches have been built at the later date, but their moulding has been determined by the outer springing having been constructed along with the outer jambs of the double window. The wall is of the period of the B mouldings, but the middle pier of the window, with the arches and vaulting rib which it carries, are of the period of the E mouldings. Why this middle pier at each extremity of the eastern aisle should have been delayed is another question to be considered afterwards, but the fact appears to us indisputable.

In the north-eastern chapel (fig. 42) we have a repetition of the conditions found at the north bay of the eastern aisle. The four diagonal ribs have the early moulding, while the intermediate rib in the axis of the north aisle, and springing from the pier between the windows, is of the later section. From this we judge that the springers of the diagonals, or some of them, are of the early date, while the vault itself, and the pier between the windows, are of the period of the E mouldings.

The other three chapels are carried out wholly with the later moulding, the one to the south having the axial rib between its eastern windows. The question naturally arises whether the springers of the diagonal ribs in these three chapels were not also constructed in the period of the B mouldings. We are unable to answer definitely, but it is obvious that the springers of that date, if there ever were such, have been eradicated and their places taken by springers of the period at which the vaulting was constructed.

It will be understood that all the heavy arches which spring from the three pillars I E, II E, and III E (fig. 6) were built at the early period, that is, about 1240. These pillars support the great eastern gable of the choir, and the arches in question are required to reinforce the pillars, to which they act as a kind of flying buttress. With these arches most of the springers of the

eastern aisle must also have been constructed, and the early mouldings of the springers and of the aisle vaulting are thus easily accounted for. We must suppose the arches which separate the chapels to have been built also at this time, and it is not clear why the springers of the diagonals of three of the chapels should not also have been formed along with the main arches, or, if so formed, why they should have been removed. What seems perfectly clear is that all the springers of three of the chapels, and one of the springers of the fourth, are of the same date as the vaulting and carry the moulding which belongs to that period.

It will be noted that there are four intermediate ribs springing from the piers of two-light windows which in each case form the termination of an aisle. The north and south aisles finish at the east end in two of the chapels, each of which has this intermediate rib, while the windows at each extremity of the eastern aisle are also possessed of the rib. The same feature is found in the upper vaulting in the chapels which form the eastern termination of the aisles of the choir, and apparently the rib was designed to close the vista of the aisles effectively. In the lower vaulting all four intermediate ribs are of the E₂ moulding, and obviously the piers from which they spring are also of the period of the E mouldings.

The fifth period of the vaulting is found, as we have seen, at both ends of the lower church, in the western stairs and in the eastern aisle and chapels, but it is found under somewhat different conditions. In the vaulting of the transeptal stairs the designer has been almost untrammelled in his work—so far as the vault is concerned the plan is his own. In design, therefore, as well as in its mouldings, it is wholly of the period in which it was built. In the eastern vault, however, it is quite otherwise. There the work is merely the completion of a design of earlier date—the continuation of the vaulting of the north and south aisles. Although constructed at the later date its design is that of the earlier period, the only important modification of the original design

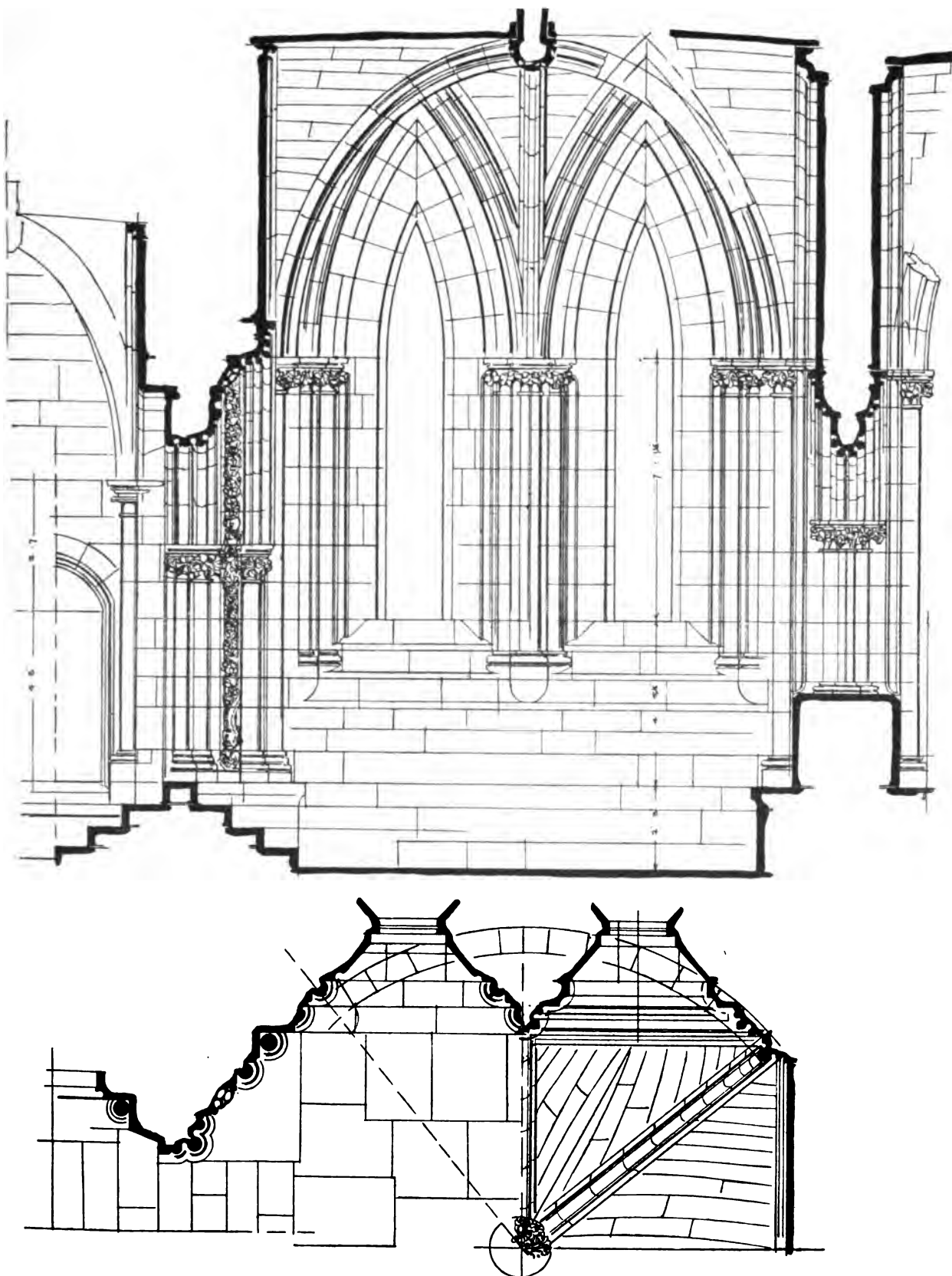


Fig. 42.
North-East Chapel of Lower Church.

being the four axial ribs, which were probably not included in the original plan. As the builders had not only to carry out the early plan, but to avail themselves of a large proportion of the springers of that date, there was little left for them to initiate, but when the opportunity arose to introduce a moulding of their own time they were not slow to avail themselves of it.

The only feature that connects the eastern and the western sections of the fifth period of our vaulting is the similarity of the mouldings, but this, we think, is sufficient to stamp them as being pretty nearly of the same date. The late mouldings of the eastern vault are those which we have called E₁ and E₂, while the vaulting ribs of the stairs are of the E₃ moulding, Fig. 5.

The choir vaulting was now complete, the finishing touches having been added at both extremities of the lower church. From the beginning of the work by Walter, during its prosecution under Bondington, and down to its close perhaps in the first peaceful years of Robert Wishart's prolonged and stormy reign (1272-1316), many changes had taken place. The wave of popular enthusiasm on which the project of the building had been launched had for some time subsided. It may be asked why so long an interval should have been allowed to elapse between the completion of the middle vault and the resumption of the work at the eastern aisle and chapels and the western stairs. As soon as the middle vault was finished, there were matters of greater urgency than the vaulting of the extremities of the lower church to be attended to. There was the translation of the bones of the saint to their final resting-place in the middle of the crypt—a task which involved the reconstruction of the vault of Walter's chapel, and was followed probably by the completion of the aisle above the temporary chapel. There was also the erection of the high altar, with the fittings and adornments of the choir, on which we need not doubt the resources of the See were lavished for some years. If we assume the retro-choir to have been either screened off from the main building or

laid with a temporary flooring of wood, the choir itself would be available for the services of the church, and the efforts of clergy and people for a number of years would be devoted to making the structure all glorious within. The lower church would also be available for worship throughout the greater part of its area. Although the stair vaulting had not yet been executed, the stairs themselves in some form probably existed, so that to all intents the choir was a completed building. We cannot give the precise date of the final stage of the vaulting, but from about 1270 the plan of the stair vaults became possible. The mouldings seem to be later than that date, but they are not sufficiently distinctive, so far as our present knowledge goes, to found much upon them.

Between Bondington's time and that of Robert Wishart the See was in an unsettled state. Wishart became Bishop thirteen years before the death of Alexander, and during that period, and perhaps also in the more troubled times that followed, some effort would be made to finish the choir. While the evidence is not sufficient to enable us to fix more definitely the date of the completion of the vaulting, it should not be beyond the power of archæology to determine it.



Chapter VIII.

The Mouldings.

WE have seen that the vaulting of the choir is of five periods, and our illustration of the vaulting ribs (fig. 5) shows that the mouldings divide themselves into five corresponding groups. Any one who is even slightly versed in the subject will recognise that each of these groups represents a different date in vaulting, that the sequence of the several groups is perfectly clear, and that in most cases the actual date of each may be determined within a few years. When it is added that each successive stage of the vaulting introduces its distinctive type of moulding, it will be seen that in its main lines the chronology of the vaulting is as plain as anything in archæology; that we have only to follow out each stage of the vaulting or each class of mouldings intelligently on the plan to acquire a general grasp of the history of the building. To those who have the requisite knowledge of architectural detail an outline of the structural history of the choir is comprised in the coloured diagrams, Figs. 5, 6, and 7.

We have traced the sequence of the vaulting periods with the general design of each part of the work as our guide, and it is not necessary to go over the same ground with the mouldings; we shall confine ourselves, therefore, to a few notes on the character and distribution of the vaulting ribs of each class. It is perhaps from the mouldings that we realise most fully the regularity and rapidity of development that characterised the architecture of the middle ages, and particularly that of the 13th century. A new moulding is brought into existence, undergoes a series of modifications of form, and finally gives place to something different and better adapted to

the new conditions that have sprung up. There is a certain harmony between the particular stage of the architecture and the mouldings with which it is carried out; a change of moulding is therefore a necessary accompaniment to each development of the style. The moulding is the microcosm of its period, and the history of fifty years of vaulting is reflected as faithfully in the profile of a few mouldings as in a volume of illustrations.

Among the mouldings of a mediæval building there is none more distinctive of its period than that of the vaulting rib. Caprice had little to do with the design of any class of mouldings, but least of all with that of the vaulting ribs, which may be described as the direct product of the vaulting plan, though of course influenced by other circumstances. The number, the curvature, and the span of the vaulting ribs and the composition of the vaulting springer were the factors which mainly influenced the design of the moulding. We have thus to each stage in the development of the vault its appropriate type or types of moulding, and, generally speaking, the character of the vault may be recognised from its rib moulding as readily as the species of a tree is known from its leaf. Exceptions and anomalies there are, but these are more prevalent in the middle and later stages of vaulting than in the earlier ones; in the period with which we are concerned they are comparatively rare. In the earlier half of the 13th century the types of moulding in the vaulting rib were fewer in number and less subject to local variation than subsequently. They form, therefore, a more reliable index of date.

There is one other consideration that applies to the vaulting ribs of every period — the number of mouldings employed simultaneously in a particular building was very small; as a rule, an entire vaulting system was carried out with two or three mouldings only in the vaulting ribs. There are several reasons for this, both practical and æsthetic, which need not be discussed at present. Sometimes we find earlier and later parts of a vault

carried out with a moulding of the earlier period, as in the case of the Norwich cloister, and sometimes we find them with earlier and later mouldings; but the vault of one period is commonly carried out with no more than two or three mouldings, variations very often of a single type. A great variety of rib mouldings, such as we find in the lower vault at Glasgow, is, therefore, the infallible sign of a variety of date. We shall find reason to believe that this vault was originally designed to be carried out with no more than two vaulting ribs, B₁ and B₂ Fig. 5, a third moulding, B₃, which is rather that of an arch than a vaulting rib proper, and a few heavy arches of the same type of moulding.

Apart from wall ribs and ridge ribs, the vault of the 13th century is usually constructed with two ribs, a larger and a smaller variety of the same moulding, and sometimes, as in the stair vaults, with one rib only. Occasionally, as we see in the north aisle of the choir and elsewhere, the two ribs are of different periods, a new moulding having been introduced before the preceding one has been discarded. These instances may be regarded as marking the point of transition from one type of moulding to another.

The earliest mouldings of our series (coloured blue on Figs. 5 and 6) are those of Walter's chapel, where A₁ is the transverse, and A₂ the diagonal rib. The moulding is a characteristic and not uncommon one of the early part of the 13th century. It occurs in the choir of Rheims Cathedral in work described by Viollet-le-Duc as dating from about 1220,* and it appears among the sketches of that building made by Vilars de Honecort in preparation for his own work in the choir of Cambrai Cathedral.† A similar moulding is found nearer home in the nave of Jedburgh Abbey, and in many other buildings of the early pointed style.

The second stage of our vaulting introduces the second group of mouldings, the B ribs (coloured purple on Figs. 5, 6, and 7), and here again we have a characteristic moulding of the period, and

* "Dictionnaire d'Architecture," Vol. IX., pp. 206 and 207.

† Plate LXII.

one that was used in a great number of our cathedrals. It is typical of its period, and if there were no other evidence it would almost sufficiently indicate the date of the north and south aisles and of the original springers of the entire lower vaulting.

The mouldings B₁ and B₂ pervade the whole lower church, either in their original condition, as in the aisle vaulting, or altered as in the outer springers and ribs of the middle compartment, but in B₃ we have what is apparently a striking exception to the rule of the repetition of vaulting ribs—a moulding which occurs only once in the Cathedral. It is the moulding of the rib which springs from the west side of the pillar in the middle of the eastern gable, II E, Fig. 6, between two diagonal ribs of the B₁ section, and it is important in its bearing on the restoration of the early plan. As a unique vaulting rib in the midst of an extensive system of vaulting, we doubt if a parallel to it could be found. If the vault were of one period, or if the original plan of the middle compartment had been carried out, it would be inexplicable. We shall see afterwards that in our conjectural plan of the early vault it falls naturally into its place as one of a series of ribs or vaulting arches.

While the walls and pillars of the main choir were in process of construction the B mouldings were going out of use elsewhere, and a new type, the C moulding, was coming into employment. When the vaulting of the north aisle of the choir (*see* fig. 7) was reached, the designer, hesitating, apparently, between the earlier and later mouldings, decided to employ them together, the C moulding in the transverse ribs, and the smaller B mould in the diagonals. When, however, he came to construct the vault over the south aisle the B mouldings were definitely discarded and the C mouldings only employed. We see here the B mouldings at the very moment of their disappearance with the introduction of the C mouldings, at first tentatively in some of the ribs, and afterwards throughout. We find also at this time in the retro-choir the B mouldings used

in the narrower vault of the chapels and the larger C mouldings in the wider vault of the aisle. A little earlier the whole upper vault would doubtless have been carried out with B mouldings only, and a little later with none but C mouldings. At the point of transition from the earlier to the later type we find them for a moment in use together. When, after the completion of the clerestory walls, the builders returned to the vaulting of the lower church, the B mouldings were obsolete, and their presence in considerable number in the middle and eastern vaulting is due obviously to the springer stones that had been constructed along with the lower walls and main pillars.

The rib which we have called B C and coloured green (figs. 5 and 6) is one that occurs four times only in the Cathedral, in each case rising from an outer springer of the middle compartment. It is clear in one case that the moulding on the springer must have been originally the B₂ mould, as shown by the dotted line at B C, Fig. 5, and that it has been altered at the period of the middle vaulting into the later form. As altered it shows a fillet or band on the lower edge in place of the plain rounded outline of B₂. A suggestion may be offered as to the purpose of such an alteration, and a point of distinction noted between the earlier and later groups of mouldings.

The construction of a vaulting rib, like that of any other arch, requires the use of centering, the wooden framework employed to maintain the arch stones in position till the completion of the arch with its abutments, and the hardening or setting of the mortar with which it is built. Until the arch has been locked by the placing of the keystone or boss of the vault, the upper stones are supported mainly by the wooden centering. The earliest of our rib mouldings (A₁ and A₂) are pointed in section, while those of the B group are rounded on the under side, and neither of these forms is well adapted to rest securely on the wooden centering during the construction of the arch. When the third group of mouldings was

evolved with its double roll and hollow on the under side, the builders found the convenience of a voussoir that would rest steadily on the temporary support of the arch. We find accordingly that all the later mouldings of our series are either flat or hollowed on the under side, and by this means one of the minor difficulties of vaulting was avoided.

When the builders of the middle vault decided to retain as many of the original springers as could be adapted to the new design, they had to submit to the inconvenience of the rounded form in the B mouldings, or to alter them on the springer. In the great majority of the ribs the original moulding has been retained, but in the case of one original springer, that of III S, Fig. 6, a slight alteration has been made; a band or fillet has been wrought on the under side of sufficient breadth to steady the stone on the centering, and the moulding has been transformed from B₂ into B C, Fig. 5, as shown by the dotted line on the drawing of the latter moulding.* In three springers of a later date this moulding is repeated; as the change in appearance is slight, as the ribs are in deep shadow, and as the moulding occurs irregularly, it may be presumed that the experiment was made rather with a view to the convenience of construction than with reference to the appearance of the moulding.

As the second group of mouldings was introduced in the second vaulting period and continued in the third, so we find the third group introduced in the third period and continued in the fourth. In C₁ and C₂, coloured red on Figs. 5, 6, and 7, we have again a moulding thoroughly characteristic of its period. The C type of moulding succeeded the B type not only in Glasgow Cathedral but throughout England, and it constitutes one of the distinguishing marks of the vaulting of the middle of the 13th century. It is a moulding of much richness and beauty; its complexity stamps it as a vaulting rib that could have been

* See Chapter XI.

employed only after the difficulties of the springer had been fully mastered, and before the intricacy of the vaulting plan had been increased by the addition of the tierceron. Its period is accordingly short and perfectly defined. In the middle area of the lower church the C mouldings are used in the arches which spring from the central pillar to the four angles of each of the larger squares, and in the half arches which spring in the cardinal directions from the same pillars. It occurs also in three of the ribs of the eastern section of the middle compartment.

The fourth stage of the vaulting, the middle compartment, introduces the fourth variety of the mouldings, represented by D₁ and D₂, coloured orange on Figs. 5 and 6. These are perhaps less typical than any of their predecessors; they are, however, sufficiently distinctive for our purpose. The date of the vault in which they occur is besides determined beyond question by its general design and by the continued employment of the C mouldings, now approaching the term of their existence.

We have thus three distinct classes of rib-moulding in the middle vault, the obsolete B mouldings whose presence is due to the springer stones of an earlier period, the still current C mouldings, and the D mouldings now introduced to the Cathedral. We have seen that the B moulds are found in the large majority of the ribs which rise from the outer springers of the compartment, while the C moulds are chiefly used in the ribs which spring from the central pillars of the large figures of the vault. The D mouldings appear in the 28 ribs which rise from the four pillars of the shrine of Saint Mungo in the middle of the crypt, in the ribs of the larger squares on the sides opposite to the shrine, in most of the ribs of the domical piece of vaulting in the eastern section of the compartment, and in the transverse ribs from the pillars I, IV, V, VIII, and IX, North and South, Fig. 6.

D₃ is the moulding which encloses the domical part of the vault beneath the high altar and between the pillars IX N, and IX S; it

is more properly an oblique ridge moulding than a vaulting rib; it is in fact a ridge of which one side has been tilted up and modified to receive the ribs of the domical portion of the vault. It has been classed with the D mouldings rather on account of its position on the plan than because of any close resemblance in its section to that of the other D mouldings.

The moulding of the arch at the north-east corner of Walter's reconstructed vault, between the pillars III S and IV S, is shown at Fig. 14, p. 40. Its section stamps it as of about the date of the D mouldings, but it is not strictly one of the vaulting ribs, nor does it belong to any one of the five stages of the vault—it is rather an accident of the reconstruction than part of the vaulting system. It is not, therefore, an exception to the rule of the repetition of mouldings that prevails in vaulting.

The fifth stage of the vaulting introduces the fifth and last group of mouldings, the E ribs, coloured yellow, Figs. 5 and 6. As in the first and second periods, we find here only one class of mouldings in use, with the exception that in the eastern vault, as in the middle compartment, we have a large number of old springer stones of the B period, and consequently of vaulting ribs with the B moulding. Here, therefore, we have B and E mouldings mingled, the earlier moulding preponderating in the eastern aisle and the later in the chapels. In the transeptal stairs, although portions of the wall and the vaulting shafts are of earlier date, the springers are all of the period of the vault—if springers of an earlier date ever existed here, they have been removed. Here, accordingly, we have nothing but E ribs, the vaulting at this part being carried out with its appropriate moulding.

In the vaulting ribs of the A, B, and C groups we have a series of typical mouldings, each of which was widely employed during its own period; the mouldings are well known to everyone who is acquainted with the details of mediæval architecture, and there is no uncertainty as to their successive dates. In the D group we

have a moulding less widely employed, but still sufficiently distinctive of its period, and whose date is not less recognisable than the others. In the E ribs, however, we have a group of mouldings of a different character, introduced towards the close of the 13th century. These mouldings persisted with slight variation till nearly the close of the mediæval period. Taken by themselves, and apart from their position in the building, they are not, therefore, a sufficient index to the date of the vault to which they belong. More light is required before we can decide finally as to the date of this part of the work. The vaulting plan of the stairs is one that became possible about 1270 and that might be considerably later; the mouldings equally might be of later date; we shall at least be perfectly safe in asserting that the work is not earlier, and we are disposed to place it somewhat later, than 1270.

E1 is the moulding of the arch which divides the aisle from the four eastern chapels. E2 is employed in the vaulting of three of the chapels, and occurs also in the axial rib of the fourth chapel and those of the eastern aisle, as well as in one diagonal rib of that aisle. E3 is the moulding employed in the stair vaults.

If there is some uncertainty regarding the date of the E mouldings, there is none as to the other four groups, and the sequence of the whole series of mouldings is perfectly obvious. That is enough to establish all that has been advanced. There are five successive types of moulding, and a corresponding series of chronological stages in the general design of the vaulting, each stage of the vault introducing its own type of moulding. Characteristically we find the third group of mouldings introduced before the second has been abandoned, and the fourth before the third has ceased to be employed. The only complication, if anything so simple can be called by that name, is in the fact that in the fourth and fifth stages of the work—the delayed middle and eastern portions of the lower vault—we have a large number of original springers of the

date of the second period of the vaulting with their mouldings of the second group. We have thus, in the fourth and fifth stages of the vault, an obsolete class of mouldings mingled with those in current use. When this is understood, the general scheme and history of the vault is perfectly clear.

With a succession of different mouldings in the vaulting ribs, we

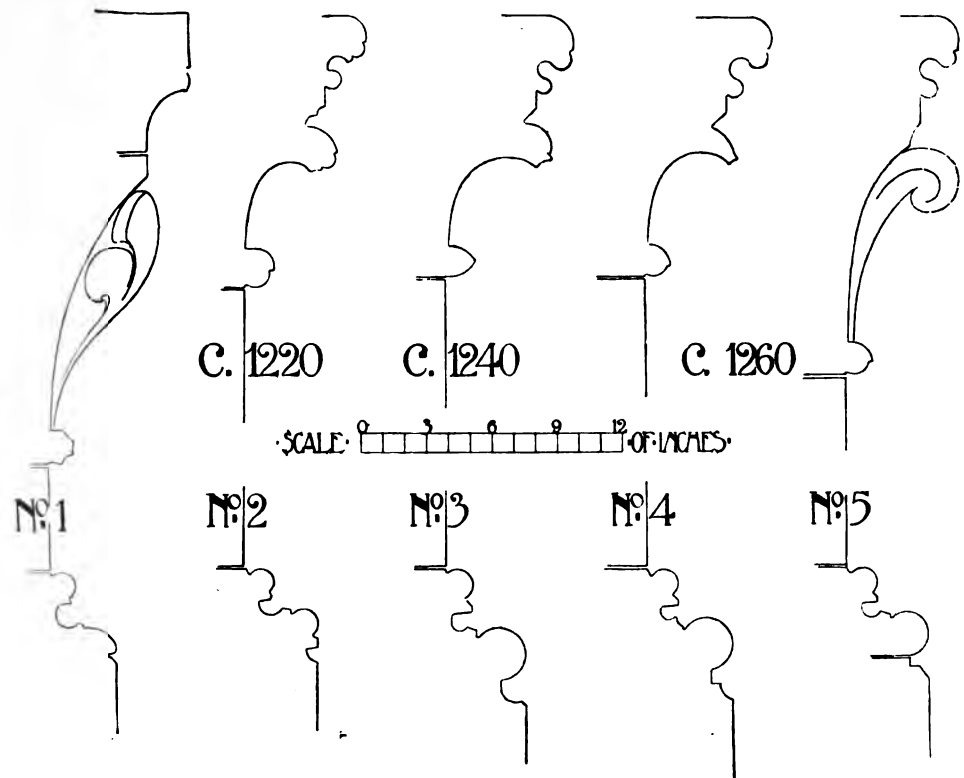


Fig. 43.

Capitals and Bases of the Lower Church.

have also a series of changes in the capitals and bases of the lower church. The earliest of the pillars is, of course, the reconstructed shaft of Jocelin's church, with its abacus and base of the 12th century, No. 1, Fig. 43. Next to this we have the capital and base of Walter's wall shafts (B and C, fig. 10), shown at No. 2, Fig. 43, and dating from about 1220. Following these, with more developed bell capitals and bolder bases, are the pillars of the aisles and main

colonnade, No. 3, of date about 1240. Lastly we have the pillars of the middle compartment, about 1260, shown at Nos. 4 and 5, Fig. 43. In the moulded capital of 1260, No. 4, the bell is carried to the last stage of refinement—even of attenuation—being in some cases barely an inch in thickness at the crown. No. 5 represents one of the graceful foliated capitals of the shrine, probably the latest of the pillars of the middle compartment.

The difference in date of the four periods is perfectly marked in the moulding of the capitals, and in most cases in that of the bases also. We see, however, that whereas the mouldings of the vaulting ribs, Fig. 5, underwent a radical alteration at each stage corresponding with the change in the vault itself, the moulded capitals and bases of the pillars were modified in a much smaller degree. The whole art of vaulting was in process of rapid development during this time; the vault of 1260 was in nearly every respect unlike the vault of 1220, and the moulding of the ribs changed with the design of the vault. But the function of the pillar with its capital and base remained the same, and the development of the mouldings was such only as reflected their altered environment or the changing taste of the period. We might suppose, further, that the designer of the middle vault, so far from desiring to differentiate his capitals and bases markedly from those of the earlier pillars, may have preferred in some measure to assimilate them with a view to the consistency of the whole design. But, in fact, the moulded bell capital and the double-bowtelled base remained in use for a long period, and the changes which they underwent were rather modifications of proportion and contour than the introduction of absolutely new features. We have thus in the later capitals and bases substantially the same members as we find in the earlier, with, of course, the added refinement of their period. The process of development is interesting in contrast with the kaleidoscopic changes in the vaulting ribs during the same period, but to the architect or the archæologist the changes are equally distinctive, and the same message is conveyed in one case as in the other.

Chapter IX.

Why the Middle and Eastern Sections of the Lower Vaulting were Delayed.

HAVING ascertained that the vaulting is of five distinct periods, it falls to us to consider the sequence of the several stages of the work and the reason for the particular order that was followed.

The earliest part of the vault, dating from about 1220, is found in the south-west compartment of the crypt, and we have seen that precedence was given to this section of the building in order to provide a repository for the relics of the saint and a chapel for service at his altar while the choir was in process of demolition and reconstruction. The second stage, about 1240, comprises the north and south aisles of the lower church. About 1250 the third stage was reached with the vaulting of the aisles and chapels of the upper church. In the following ten years the clerestory walls and east gable were under construction, and about 1260 the builders returned to the lower tier of vaulting and reached the fourth stage in the middle compartment of the lower church. For this work a new design was made superseding the original plan of 1240. The middle vault completed, another interval of time elapsed before the fifth and last stage was reached with the eastern vaulting of the lower church and the transeptal stair vaults. The date of this work is uncertain, but it is not earlier than 1270.

We have thus five periods of vaulting, with their approximate dates, which are as follows :—

- | | | |
|---------------|---|---|
| Lower church | { | 1. South-west compartment, . . c. 1220. |
| | | 2. North and south aisles, . . c. 1240. |
| Upper church. | | 3. Choir aisles and chapels, . . c. 1250. |
| | | 4. Middle compartment, . . c. 1260. |
| Lower church | { | 5. Eastern aisle and chapels |
| | | and transeptal stairs, not |
| | | earlier than 1270. |

Disregarding for the moment the small area of the south-west compartment, it will be seen that the lower vault was carried out in three sections of fairly equal area, and at three separate dates; between the first and second of these three sections (the second and fourth of our series) the whole upper building of the choir was constructed, with all its vaulting and presumably its wooden roofs. On the completion of this work the middle vault of the lower church was proceeded with, and at a subsequent period the edifice of the choir was finished by the construction of the lower eastern vault. The question naturally arises why one-third only of the lower vault should have been constructed when the walls and main pillars of the building had reached the necessary level, and why the remaining two-thirds should have been delayed till after the completion of the main fabric of the choir. It might at first sight appear more natural that the builders should have proceeded regularly from the lower to the upper work, or from one end of the building to the other. We cannot avoid asking why they should have delayed two-thirds of the lower vault till after the completion of the choir, and why an interval of twenty years should have been allowed to elapse between the lower north and south aisles and the intervening compartment of vaulting, with a further interval between the latter and the eastern vault. A little consideration will show, however, that, in view of the character of the structure and the appliances at the disposal of the builders,

the course followed was the only practicable one—the only one, that is, that would not have involved a great amount of unnecessary labour.

The choir of Glasgow Cathedral presented to its designer and builders an unusual constructive problem—a unique problem even, so far as this country is concerned,*—the problem of a clerestoried edifice having a lower church almost wholly above the level of the ground, and covered with light vaulting. At the period when the crypt was a common feature of our cathedrals it consisted of a basement or vault, for the most part beneath the level of the soil, and covered with low and massive vaulting supported by short, thick piers at narrow intervals; the walls and pillars of the main structure, on the other hand, were composed of small stones such as could be lifted and transported by the workmen without the aid of any but the simplest appliances. In such a building the upper surface of the vaulting over the crypt, only slightly raised above the level of the ground, formed a platform of great solidity where the operations connected with the movement of light materials could be carried on with convenience and safety.

The lower church at Glasgow, on the contrary, rises from twenty to thirty feet above the level of the ground; it is covered with the light and graceful vaulting of the 13th century, and the clerestory and triforium walls of the upper church are constructed with stones many of which are nearly half a ton in weight. Obviously the lower vaulting is too light to admit of such loads being freely moved about on it, and it is at too great an elevation to invite the experiment.

The line of the clerestory wall is about twenty feet within the outer wall of the building, and the eastern gable of the choir is about thirty-five feet within the wall of the eastern chapels. By what means, then, and by what route, were the large stones of the

* See the second note on page 10.

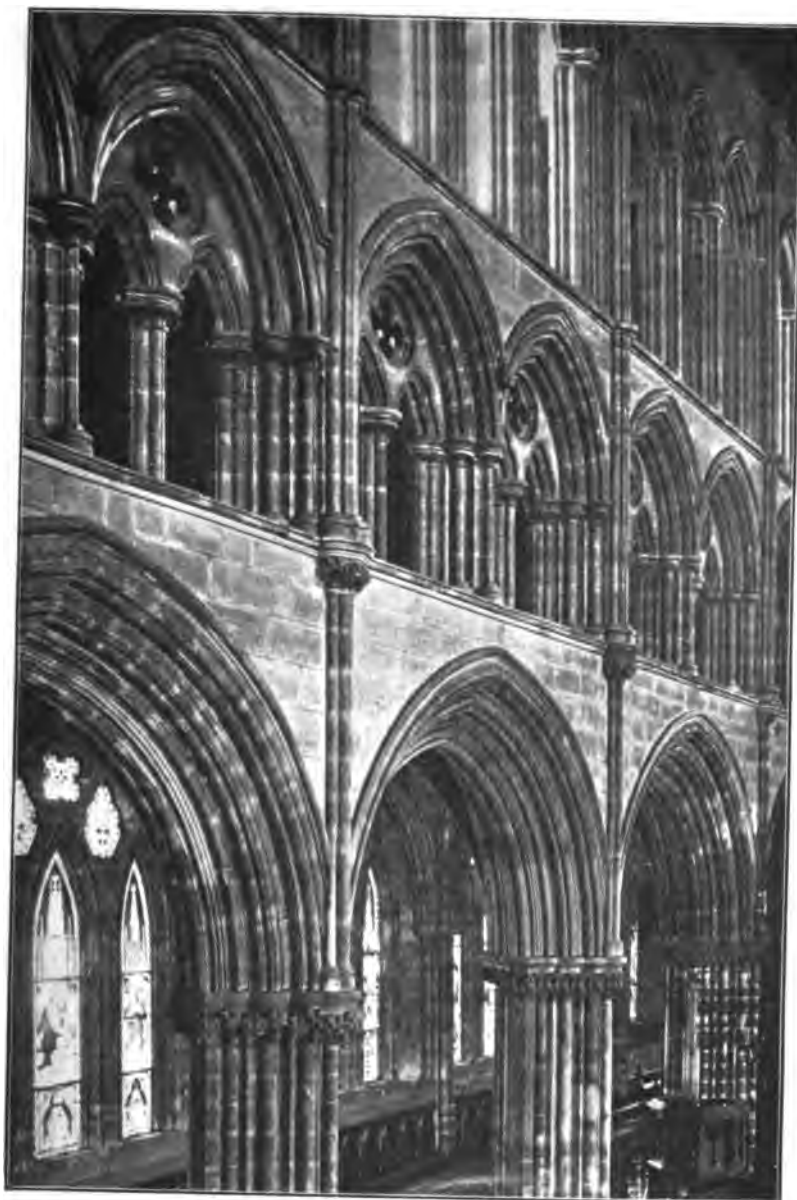


Fig. 44.
View of Clerestory.

triforium, clerestory, and eastern gable conveyed to their places at a considerable height above the ground, and so far within the outer wall of the building?

To do the work to-day we should erect a steam crane on scaffolding of the requisite height to command the building. But the 13th century possessed nothing analagous to such a machine. It had the means of raising considerable loads in a vertical direction, but it had no appliance that would swing a weight even of half a ton for some distance horizontally at a height of 50 or 100 feet above the ground. As the stones had to be built all round the clerestory, each course at a different level, it would have required a mass of heavy scaffolding, and involved great and unnecessary labour, to raise them outside the aisle walls and convey them to their places. But the mediæval builder never employed heavy scaffolding, or scaffolding of any kind in great quantities; his appliances were few and his methods as simple and direct as possible. What, then, were the means available, and what must have been the method employed to raise the large stones of the triforium and clerestory?

To answer that question we may consider for a moment the nature and extent of the scaffolding used in the middle ages, the mechanical appliances that were employed, and the process followed in conveying and raising heavy loads.

We have said that the mediæval builder worked without heavy scaffolding, and it may be added that he used the smallest amount even of light scaffolding and gangways. The buildings themselves amply demonstrate that the walls were their own main scaffolding, and supported the light wooden brackets and planks which the builders used and moved from place to place as the work proceeded. The wooden scaffolding used in the construction of the upper walls of a high building, even that used in the erection of towers and spires, was not as a rule carried up from the base of the building, but was bracketed out from the walls. It was used for the

circulation of the workers and the movement of such loads only as they could carry, never to support the heavier materials, which were raised directly from the ground on to the walls.*

As the walls were almost always built from the inside, it was necessary that the heavier stones should be wheeled into the building on the level of the ground. The absence of heavy scaffolding and of far-reaching cranes made it imperative that they should be brought as nearly as possible under the position which they were to occupy on the walls, and the appliances at the disposal of the builders required that they should be hoisted vertically. The process implied a roadway into the interior of the building; it required that the stones should be wheeled in by this roadway on such hand-carts as that figured by Viollet-le-Duc,† and that they should be hoisted directly into their places on the walls. It is obvious that to do this in the case of our Cathedral the middle vaulting had to be delayed until after the clerestory walls were built. We have seen already that it was in fact delayed for about twenty years after the completion of the lower aisle vaulting, and that during this time the fabric of the upper church with its clerestory and the upper vaulting were constructed. Had the fact not been plainly demonstrated by the altered plan and later details of the middle vault, we might still have arrived at the conclusion that it must have been so by consideration of the constructive problem which the builders had to face. It is an obvious conclusion, therefore, that the middle vault was delayed in order to admit of the heavy material of the upper walls and pillars being directly hoisted into position from the level of the ground.

* "Les matériaux de gros volume n'étaient jamais montés sur ces planchers ou *ponts*, mais sur les murs eux-mêmes, au moyen d'engins placés sur le sol correspondant à des grues ou chèvres haubanées sur la construction même. D'ailleurs, presque toujours, les matériaux étaient montés par l'intérieur, bardés sur les murs, posés et jointoyés par les ouvriers circulant sur ces murs mêmes ou sur les échafauds." Viollet-le-Duc, "Dictionnaire de l'Architecture," Vol. V., p. 104.

† "Les matériaux étaient apportés à pied d'œuvre sous le bec de la grue au moyen de grands binards ou fardiens à deux roues, ainsi que l'indique la fig. 6." "Dictionnaire de l'Architecture," Vol. V., p. 218.

With regard to the nature of the machinery employed at this time, it is to be noted that up till the latter part of the 12th century only small stones were used in building in this country, and it may be inferred that only the simplest mechanical appliances were employed in transporting or raising them. The stones were, indeed, such as could be handled by the unaided efforts of the workers. With the advent of William of Sens at Canterbury in 1174, or at all events about that date, improved methods and new machinery were introduced into England. At the very outset of his work, as we are informed by Gervase, "he constructed ingenious machines for loading and unloading ships and for drawing cement and stones."* The work of the Frenchman at Canterbury is in evidence, and is distinguished from that of his predecessors, not only by its design, but by the greater size of the stones of which it is constructed.

In the 13th century the advance of mechanical skill was such as to make the use of comparatively large material general in the more important buildings. It is obvious that the larger stones of the triforium and clerestory at Glasgow could not have been raised to their places, from 50 to 100 feet above the ground, without the aid of machinery of some kind. We have then to inquire what was the nature of this machinery.

The mechanical appliances of the 13th century included the windlass, pulley, and screw, with a variety of adaptations of the lever and inclined plane. The motive power was chiefly manual, though draught animals were also employed. The windmill was well known, and hydraulic power had been employed in a very primitive manner,† but neither of these could have been used for such a purpose as we are considering. The hoisting apparatus in use was mainly of the windlass and pulley type, and was capable of a

* "Willis, Canterbury Cathedral," p. 36.

† See Vilars de Honecort, Plate XLIII., on which a rude appliance for sawing timber, actuated by water, is depicted.

direct vertical lift only; it could not transport a load horizontally for some distance above the level of the ground without heavy scaffolding. There was no means open to the builder of raising a heavy load to a considerable height except in a direct vertical line, and it thus became a matter of necessity that the middle of the choir at Glasgow should be left open from the level of the ground upwards until the clerestory walls were finished.

The most powerful hoisting apparatus that was known at the middle of the 13th century was a kind of screw-jack, which comprised a screw with a travelling block or nut sliding between vertical runners. This machine appears in Vilars' sketch-book with the note, "This is the way to make the most powerful engine known for raising weights."*

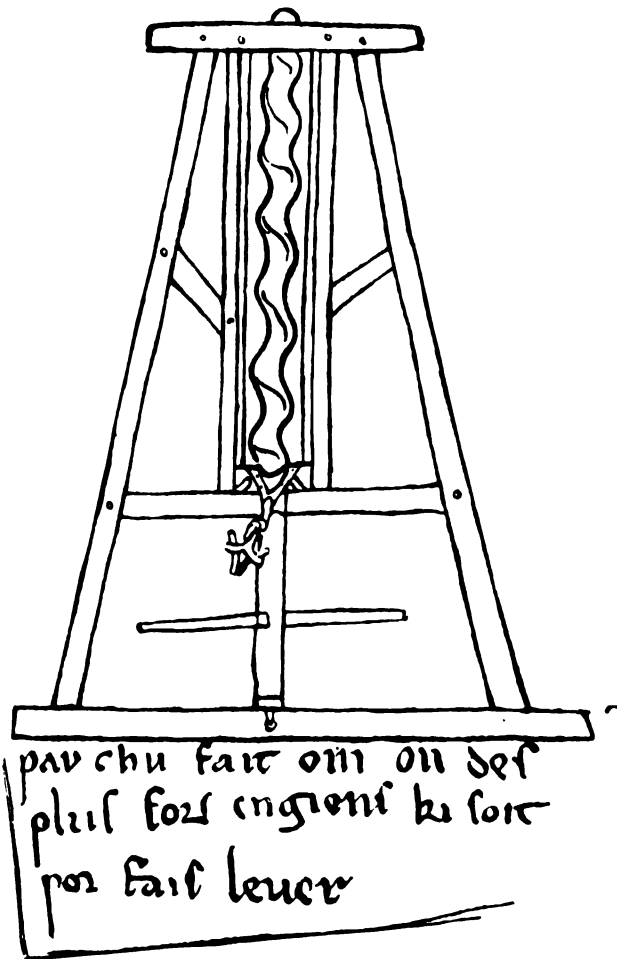


Fig. 45.
Vilar's Machine.

Fig. 45 shows Vilars' sketch, and we refer the reader also to Viollet-le-Duc's transcript of the drawing and his description of the apparatus.†

* Willis' translation. The original runs, "Par chu fait om on des plus fors engiens ki soit por fais lever." Vilars de Honecort, Plate XLIII.

† "Dictionnaire de l'Architecture," Vol V., p. 217.

We do not suggest that Vilars' "most powerful engine known for raising weights" was employed at Glasgow or in the majority of the churches of the period. Had it been in common use the probability is that Vilars would not have thought it necessary to depict it. But it is certain that a hoisting apparatus of some kind was employed—some application, it may be supposed, of the windlass wrought by men on the ground, and directed by a foreman or by those who were to receive and set the stones on the wall. The rope would pass over a pulley on the jib of a short crane or attached to a beam or bracket at a suitable height, one end would be wound on the drum of the windlass, and the other would terminate with a "lewis" for grappling the stone to be raised.

It will be noted that a "lewis," the same in principle as that in common use to-day, is indicated on Vilars' drawing, Fig. 45, and it is evident that a rope is implied though not shown. The "lewis" depicted consists of three pieces of wrought metal, two of which are dropped into a hole cut in the upper surface of the stone to be lifted. This hole is undercut or dovetailed in form, and the outward pressure of the two curved pieces of metal, clasped together by the third piece in the form of a double loop, holds the stone firmly until it reaches its destination, when the relaxation of the strain releases the stone.

As the simplest and most convenient attachment for clutching a large stone the lewis was widely employed, and it is interesting to find it figured in a drawing of the 13th century. Willis mentions that a writer in the "*Archæologia*" has described certain stones which he found at Whitby Abbey, each of which had two holes, diverging downwards, bored in their upper surfaces, evidently for the reception of some kind of lewis, and he adds that these two holes would have suited Honecort's lewis as well as a single hole.*

* Vilars de Honecort, p. 163.

We have, however, direct evidence that the lewis was employed at the Cathedral of Glasgow. In conversation with a working mason who had been employed during a considerable time at the building,* the writer was informed that five or six years ago, while executing some necessary repairs, he had cut into a lewis hole in one of the larger stones of the upper walls of the choir. We have here the proof, if any is required, that the stones were raised from the ground by means of a mechanical appliance of some kind. Whatever its nature, we judge that the delay of the middle vault was due to the necessity of raising the stones directly from the level of the ground to the upper walls of the sanctuary.

The dressed stones for the main pillars, triforium, and clerestory had therefore to be brought into the building as a preliminary to being hoisted into their places; for this purpose it was necessary that a roadway should be provided into the middle compartment, and that this should be kept open until the completion of the clerestory. A glance at the plan of the lower building will show that no opening of sufficient width could have been formed between the pillars of the north and south aisles. Although only the major pillars of the lower aisles are beneath the pillars of the choir, the smaller intermediate pillars, and the arches which they carry, are necessary to the stability of the structure, and the whole range must have been built at one time. The width between the bases of the pillars at each side of the middle compartment is only 3 feet 6 inches, and this is manifestly insufficient for the larger loads or even the ordinary traffic of the building. The openings between the eastern pillars, however, offer a clear width of 6 feet 6 inches between the bases, and form the only possible access for the hand-carts or other vehicles on which the heavier material had to be conveyed into the middle of the building. The chief part of the dressed stone for the clerestory walls must therefore have been brought in through the two large archways under the eastern gable

* Mr. Alexander Forrest, Cleveland Street, Glasgow.

and by way of the eastern aisle. It follows also that a roadway must have been formed from the exterior of the building into the eastern aisle, and for this purpose one or more wide openings must have been left in the outer walls. This could only have been done by leaving unbuilt the middle piers of the two-light windows of the eastern aisle or of the eastern chapels. But we have already seen from the mouldings of the vaulting ribs which spring from the middle of the two-light windows that these piers *were* left unbuilt until a late period—the period of the E mouldings—and we now see for what purpose they were delayed. Once more we have a double proof—the constructive problem shows that these piers, or some of them, must have been delayed until the completion of the clerestory to admit of a roadway into the building; the mouldings show that they *were* so delayed.

It seems probable that the roadway was carried right through the eastern aisle of the lower church, branching off at right angles into the platform of construction of the middle compartment (fig 46). By this route the heavier loads could be wheeled in from either side of the building and brought right under any part of the clerestory walls, the stones could be grappled by the lewis and hoisted vertically from the trolley by means of a windlass, and finally settled in their places with the assistance of a short crane or jib. If we assume the mason's yard to have been on either side of the choir, or on both sides, the fall of the ground would lend itself to a slight inclination of the roadway which would permit of a heavy load being moved with great facility. The window openings of the eastern chapels would give additional means of communication, or they may have been left unfinished mainly for the admission of as much light as possible. It is obvious that if the original plan included the axial ribs which spring from the piers of four of the two-light windows, the vaulting could not have been completed so long as these piers were unbuilt. In any case it was not desirable that the eastern vault should be constructed before that

of the middle compartment, as all the light that could be got was required during the completion of the middle vault. Apart, therefore, from the evidence of the mouldings, and the necessity for a way into the middle of the building, it would have been a safe assumption that the eastern vault, and not the middle compartment, must have been the last part of the lower vault to be carried out.

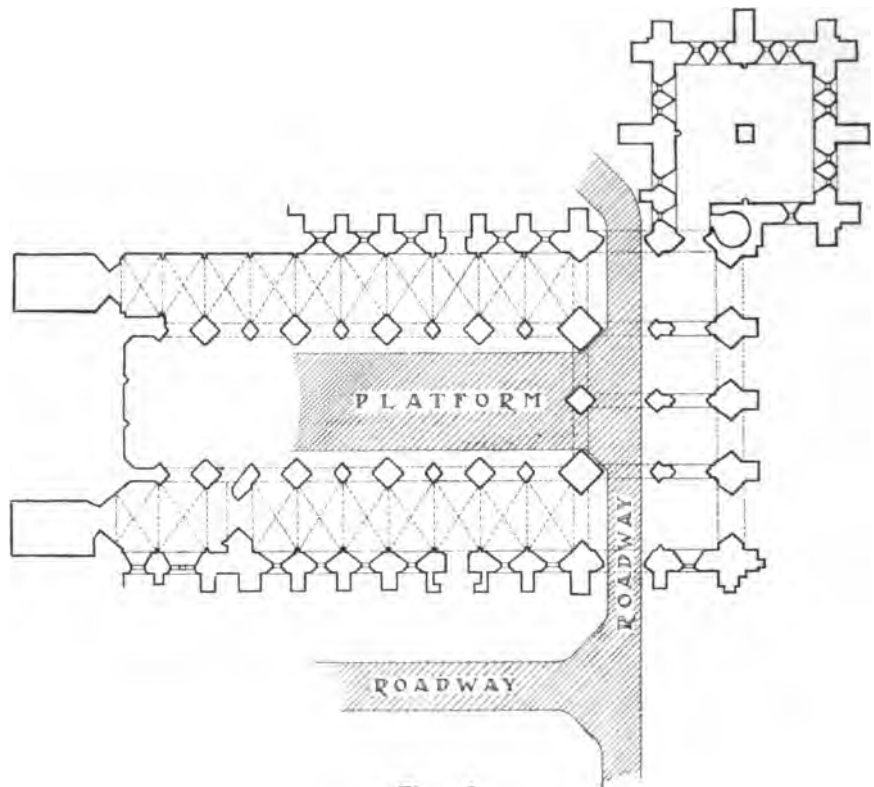


Fig. 46.

Diagram of Roadway into Church.

The evidence of the late mouldings, however, removes the subject from the region of conjecture into that of ascertained fact.

The question may be asked whether it is altogether certain that the vaulting of the lower north and south aisles was completed as the walls and pillars were built, or whether it may not have been delayed above the springers and afterwards completed without modification of the original design. In the

absence of any reason to the contrary, the practice of the mediæval builders was to finish the vaulting as the building was carried up. In the present case, so far from impeding the progress of the work, the completion of the aisle vaulting, both of the lower and upper levels, would be of service in affording facility of circulation to the workers, and it may be assumed that the vaulting was completed as the building was carried up. It is usually possible to distinguish vaulting that has been delayed from that which has been constructed along with the building, and an examination of the work leaves no doubt that the vaulting on each side of the middle area was completed at the date which its style and details indicate.

The constructive problem which the builders of our Cathedral had to solve was altogether exceptional in respect that the choir consisted of an upper and lower church, the latter being arched over with light vaulting and rising to a considerable height above the ground, and the former having a clerestory wholly within the aisle walls, in the construction of which comparatively large stones were employed. In the few existing under-buildings, or extensions of crypts, which date from the 13th century, such as those of Rochester and the Lady Chapel at Hereford, the problem of upper and lower aisles and clerestory does not occur, nor is it found in double chapels such as Saint Stephen's, Westminster, and Sainte Chapelle, Paris. Neither was it encountered where a cathedral of the 13th century was constructed over an older crypt, with its heavy and solid vaulting, but little raised above the surrounding soil, and offering thus a convenient platform of construction. It may be pointed out that at Glasgow our positive knowledge of the fact that the middle vault was delayed is due to the circumstance that it was delayed long enough to allow the art of vaulting to develop in a marked degree, and that a new design in the later style was substituted for the earlier one. In any similar case that may exist, if the original design of the middle vault at the

lower level has been carried out, it might be more difficult to determine with certainty whether its execution had been delayed or not. If the conditions otherwise were the same, the presumption would be that it had been delayed for the same reason as that at Glasgow, but it would require careful examination to decide the point by direct evidence.



Chapter X.

The Superseded Plan of the Middle Vault.

It is not a little remarkable that the difference of date of the design of the lower aisles and that of the middle vault, with the obvious and necessary inference of a superseded plan of the latter, should have remained so long unnoticed. Sir Gilbert Scott was not very far from the discovery when he spoke of the "natural" method of vaulting the middle area. His visit to the building, we should think, must have been a brief one, without the aid of artificial lighting, and his description of the vault was based probably on the published drawings rather than on the work itself; had he compared or contrasted the design of the several sections of the vaulting or collated the detail which he commends, he could scarcely have failed to recognise the variety of style, with its corollary the change of plan.

Still more curious and interesting than Scott's reference to the subject is the fact that another well-known writer should have been almost on the brink of the discovery without actually reaching it. In his description of the building Fergusson says:—"The glory of this Cathedral is its Crypt, which is unrivalled in Britain, and, indeed, perhaps in Europe. As already remarked, the English Crypts were built during the Norman period, or very early in the age of the pointed style. That at Glasgow belongs to the perfected style of the 13th century, and as the ground falls rapidly towards the west,* the architect was enabled to give it all the height required, and to light it with perfect ease. Here the Crypt actually extends under and beyond the whole choir. Had there been an opening in the

* This should be "towards the east."

centre of the vault (and it is by no means clear that one was not originally intended), it would be more like a German double Church than anything found in England. There is a solidity in its architecture, a richness in its vaulting, and a variety of perspective in the spacing of its pillars, which make it one of the most perfect pieces of architecture in these islands."*

There is not the slightest reason to suppose that an opening in the vaulting was ever intended, the contrary, indeed, being manifest; but the quotation suggests that Fergusson may have carried away an undefined impression of a difference in date between the aisles and the middle vault, and of a possible change of plan in the latter. Such as it is, it is the nearest approach to the recognition of the facts that we are aware of previous to that referred to in the Introduction to the present volume.

It is hardly necessary to say that the original design of the middle vault, prepared at the period of the north and south aisles, must have been of the style that prevailed at that time; it could not have exhibited a stage of development that had not yet been reached. It was, therefore, quite unlike the vault as we now see it, and possessed neither the large squares with central pillars, nor the oblong eastern division with its flat domical vault, features that recall the chapter-house vault of the middle of the 13th century; these are features of later date than the aisles, and could not, therefore, have belonged to the early plan. We know also that the vault must have been designed for the type of mouldings in use at the period, the type employed in the vaulting of the north and south aisles. We may go further, in the knowledge that rib mouldings were never multiplied unnecessarily, and with the springers themselves in evidence, and assert that the vault was to have been carried out with the same mouldings as those used in the aisles, the B1 and B2 mouldings, with the addition of a third

* "Handbook of Architecture," by James Fergusson, 2nd edition, pp. 899 to 901. London, John Murray, 1859.

and heavier moulding, B₃, which we find in one of the outer springers of the middle compartment. We begin, then, with a general knowledge of the type of vaulting to which the early plan must have belonged; we know the rib mouldings with which it was to have been carried out; lastly, we have a certain number of the original springers of the outer pillars and wall shafts of the compartment to indicate, as far as they go, the number and direction of the ribs on the early plan.

Before entering upon our examination of the springers there are certain outstanding facts which force themselves on the attention of the architect on a cursory inspection of the vault. It is seen that some of the outer springers remain in their original condition, that some have been altered, rudely enough in most cases, and that others have been taken out and replaced with springers of the later period. It is obvious that a proportion of the ribs on the original springers have been cut away altogether and nothing inserted in their place, showing that the early plan was designed with a number of ribs in excess of those which were required for the later design. It is apparent also that many of the ribs which rise from outer pillars have been altered from the direction which they were originally designed to take.

When it is observed that the altered direction of the ribs takes effect at the level of the upper bed of the springer, it will be obvious that these particular springers, in most cases at all events, belong to the early plan, and that the builders have retained as many of the original springers as they were able to adapt, more or less successfully, to the later design of the vault. It is very much to our present purpose also to note that from these original springers we may be able to recover the direction which the ribs were intended to take in the superseded plan.

Most of the springers are about two feet four inches high; they are thus rather more than one-third of the height of the vault measured vertically from the level of the top of the capitals

to the apex of the vaulting arches. In one-third of its height a rib or arch has room to develop its curvature and direction, and, as the vaulting rib of this period consisted almost invariably of a single segment of a circle, it should not be difficult, where the springers are unaltered, to restore the whole rib as originally designed, from the executed portion which remains. We conclude, then, that as far as these original and unaltered springers will carry us we may with some confidence restore the superseded plan of the vault. Unfortunately only a few of the springers are wholly unaltered, and with the altered and renewed springers the difficulty of course will be much greater.

There is one other preliminary consideration to be noted. Although no part of the original scheme of the middle vault remains, with the exception of the springers referred to, we must not assume that none of it was ever constructed. It is quite possible, on the contrary, that some portion of it may have been carried out either at the period of the aisles, or, some twenty years later, before the existing vault was designed or the original plan discarded. We shall return to this point later, and at present merely note that if any part of the middle vault, in addition to the outer springers, was constructed at the earlier period, it must have been with a definite purpose in view, and presumably it could only have been done to such extent as would not interfere with the work of the builders in bringing in and raising the stones for the clerestory walls.

The middle compartment beneath the choir occupies a space about 90 feet long and 30 feet wide, and is divided along each side into ten bays, corresponding with the five bays of the choir. Owing probably to the work having been begun on Walter's plan and continued on that of Bondington, the western bay of the choir is narrower than the other four bays, and for the same reason, and on account of the thickness of the wall at the base of the tower, the western bay of the lower church is considerably narrower than

any of the others. As each bay of the choir corresponds with two bays of the lower church, the pillars of the latter are alternately larger and smaller, the major pillars having to support the pillars of the upper building while the others have nothing but their arches and vaulting, with the floor of the choir above, to carry.

The west end of the middle compartment at the base of the tower is divided into three bays in the width by means of wall shafts, while the east end consists of two bays only, formed by the angle piers and one intermediate pillar supporting the pillars which carry the eastern gable.

The outer springers of the compartment are thus 25 in number. There are four on the west wall and three at the east end, including the angle pillars in each case, and there are nine on the north range of pillars, and the same number on the south. For convenience of reference we have numbered the shafts and springers of each range. Those at the west end are called I W to IV W, and those of the east end I E to III E. The pillars of the north range are numbered I N to IX N, and those of the south I S to IX S, while the ten pillars of the middle of the compartment are described as I M to X M. (See Fig. 6.)

The typical early method of vaulting such an area as this, too wide and low for a single span, is of course to divide it by one or more rows of pillars into parallel ranges of vaulting. As its division into two bays at the east end is determined by the eastern pillars, the first idea that would occur to anyone is that expressed by Sir Gilbert Scott when he says :—"As the east end is necessarily divided into two bays for the support of those above, nothing would have been more natural than to have placed an intermediate row of columns down the centre, dividing the whole into two ordinary ranges of vaulting." We shall find, however, that any idea that the original plan may have followed this natural and obvious arrangement is negatived by the evidence of the springers, which points to the division of the vaulting adjoining each end of the

compartment into three bays instead of two. We shall examine these springers of the west and east ends in the first place, and consider afterwards those of the north and south ranges of pillars.

Of the four springers at the west end, the outer ones, I W and IV W (fig. 6), are in the angles formed by the buttress walls supporting the tower, while II W and III W occupy the wall between, dividing it into three bays.

All four springers are carried upon clustered wall shafts with moulded capitals and bases evidently not later than 1240. The springers include a richly-moulded wall rib or arch carried on its own shaft, and consist otherwise of transverse and diagonal ribs. They are well designed and untouched springers of the period of the north and south aisles, and correspond with the springers of those aisles, with the exception that, the severies of the western bay being smaller in both directions than those of the north and south aisles, the transverse and diagonal



Fig. 47.

Springer of III W.

ribs in the former are both of the smaller of the two mouldings, the B2 section, while in the aisles we have transverse ribs of B1 and diagonals of B2 section. These four original western springers establish the fact that the early plan of the middle vault was divided into three bays at the west end, and that it was designed to be at this part nearly as it has been carried out.

There is one point, however, that must not be overlooked. The diagonal ribs which rise from the four original springers of the west end are twisted in such a way as to indicate a slight change of direction from the early vaulting plan. We show the springer of III W looked at from the south-east in Fig. 47. It will be understood that the lowest stone of the vaulting ribs, the springer, is of the date of the aisles, about 1240 or a little earlier, the work having been begun apparently at this end. The vaulting above the springer is about 20 years later, and the diagonal rib in the middle of the photograph will be seen to be slightly deflected to the left or south from the point of junction of the earlier and later work. In some of the diagonals the deflection is more marked than in others, but in each case it is sufficiently noticeable, and in each case it is *from* the transverse rib and *towards* the wall rib; in other words, the point of intersection of the diagonals, at the crown of the vault, is nearer to the west wall than it was originally intended to be.

For an explanation of this slight change in the vaulting plan we must turn to the two pillars opposite the wall shafts II W and III W, the pillars I M and II M, Fig. 6. These pillars are of course of the later date, and, like the other pillars of the middle area, were designed for the later vaulting which they carry. They occupy one side of one of the larger squares of the compartment, and correspond as to design with the two pillars of the opposite side of the other large square, the pillars IX M and X M, except that the latter have their lateral shafts corbelled to increase the width of the intervals and so facilitate the circulation of worshippers. The pillars are octagonal in form, with an attached shaft on each of the cardinal sides, and the vaulting ribs in every case are carried on the attached shafts.

As we have explained, the western bay of the compartment was a narrow one to begin with, but its width is further reduced by the considerable size of the pillars I M and II M, and the

projection of the attached vaulting shafts on their western side into the aisle. Even without the deflected diagonals of the west wall to guide us, it would be a fair assumption that the two pillars originally designed to occupy the position of I M and II M were of smaller diameter than these pillars; they would be designed either as clustered shafts corresponding to the wall shafts II W and III W, or as single pillars of cylindrical or octagonal form. When, however, we note the deflection of the diagonals springing from the western wall shafts, indicating that the intersection of the ribs at the apex of the vault has been moved some inches towards the west, it becomes something more than an assumption. It is noticeable that the diagonals opposite to the deflected ones, those springing from the west side of I M and II M, are true in direction, showing that their springers and the ribs themselves were set out with reference to the altered position of the points of intersection of the diagonals. At Fig. 48 we give a diagram of the vault as originally planned, the existing vault being shown by dotted lines. The deflection of the western diagonals, indicated with slight exaggeration, seems to establish the fact of a change in the western vault due to the increased size of the pillars I M and II M in the later plan.

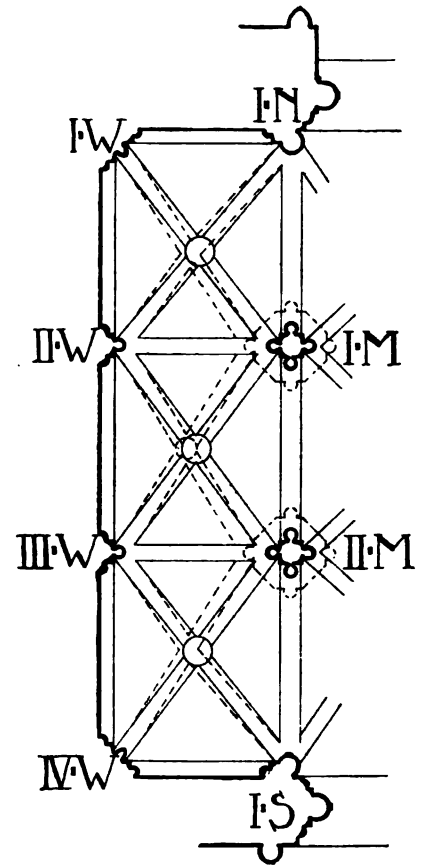


Fig. 48.

Diagram of Western Aisle.

Turning now to the other end of the middle area, a second series of original and unaltered springers will be found at I E, II E, and

III E, the pillars which support the eastern gable of the choir. Taking first the middle pillar, II E, shown by Fig. 49, it will be seen that on the west, towards the left side of the pillar in the photograph, it carries three separate ribs, each over its own shaft and independent of the others. The middle one of the three ribs is of the section shown by B₃, Fig. 5, while those on each side are of the B₁ section.



Fig. 49.
Springer of II E.

The moulding B₃ is obviously of the same family and date as B₁ and B₂. It occurs nowhere else in the Cathedral, and we have pointed out that a unique rib moulding, as part of an extensive system of vaulting, is contrary to mediæval practice; it is, so far as we know, without precedent. We are dealing, however, at present with two vaulting plans—one of 1240 that has been superseded, and the existing one of 1260 that was substituted for it—and the particular rib that we are considering belongs to both plans; it was designed for the earlier plan and

retained in the later one. The fact, otherwise inexplicable, that the rib is the only one in the building that bears this moulding may be accounted for on the supposition that it was designed as one of a series of ribs or arches in the earlier plan, and was the only one of the series to be carried out. On this hypothesis we may reason that the series of ribs, or the range of arches, to which it belonged, must have been

in some direct relation to the rib or semi-arch which is their only representative, and to the pillar from which it springs. The pillar, II E, Fig. 6, is in the middle of the east end of the compartment, directly under the apex of the eastern gable of the choir, and the rib springs axially from the west side of the pillar. If it were possible to accept a suggestion from Scott's "natural" mode of vaulting the area with a row of pillars down the middle, the position of the rib on the plan and the moulding which it bears are exactly such as to lend support to the idea of two equal ranges of vaulting divided by an axial arcade. The moulding is larger than the ordinary vaulting ribs B₁ and B₂, and perfectly adapted to a series of main vaulting arches, and the position of the rib is at the eastern end of our hypothetical arcade. On the other hand, the springer rises too steeply to have been designed for an arch corresponding to the width of bay of the lower church. We show in Fig. 50 at *a b* the actual curvature of the springer, which

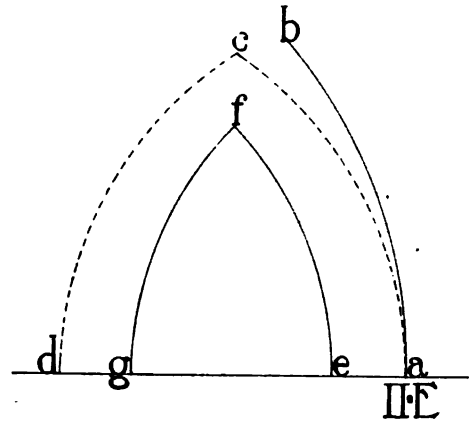


Fig. 50.

Diagram of Rib from II E.

has obviously never been disturbed or altered, and its continuation in the existing rib and at the dotted line *a c d* the curve that would have been required for such an arch, the line *e f g* representing the main arch between I E and IX N. Further, we have seen that at the west end of the compartment the vault was divided into three bays in the width instead of two. Lastly, we shall find immediately that the twofold division is negated at the east end of the compartment on the distinct evidence of the springers of I E and III E. We must therefore set aside the possibility of the division of the compartment into two equal ranges of vaulting

from one end to the other. We have indeed the evidence of the unique moulding of the axial rib pointing in that direction, but, so far as the extremities of the compartment are concerned, there is conclusive evidence against it. We may take it that the "natural" method of roofing the compartment by a double range of vaulting was not absent from the mind of the designer in preparing the

plan of 1240; that the plan involved some departure at least from this idea is evident.

We have then three ribs rising independently from three shafts at the pillar II E, Fig. 49, the B₃ rib springing almost perpendicularly in the middle, and a B₁ rib at each side. The springers, probably up to the third course, where a change of jointing of the infilling occurs, are of the period of the north and south aisles. They have not been altered in any way, and the three ribs which form their continuation of the later date are unchanged



Fig. 51.
Springer of I E.

in curvature and direction. We conclude, therefore, that at this point the existing vault coincides with that of the original plan; that the number, direction, and curvature of the ribs rising from the pillar II E, as well as their mouldings, remain as originally designed.

At each of the angle piers I E and III E, Fig. 6, there is one rib only within the middle compartment. The springers are

once more original and unaltered ones, but the ribs, unlike those rising from II E, have been changed in direction from the top of the springer upwards, the destination of the rib in the existing vault being obviously different from that of the original plan.

At Fig. 51 the pillar and rib of I E are shown by a photograph. The rib moulding is again of the B1 section. The springer of 1240 is of two courses of stone, and at the level of the upper bed, where the work of 1260 commences, it will be seen that the rib is deflected in a very pronounced manner towards the right. We have here something more than a clue; we have in the original portion of the rib a clear indication of the direction which it was designed to take on the early plan, and find that this was such as to bisect, as nearly as possible, the right angle formed by the side and end of the middle compartment. In vaulting of this date the ribs usually follow a straight line on the plan; we are justified, therefore, in

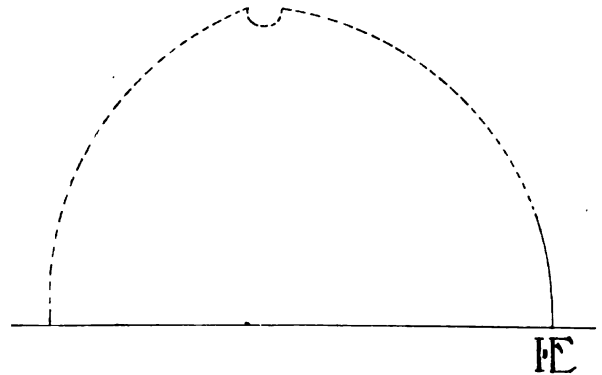


Fig. 52.

Diagram of Arch from I E.

setting it down so on our plan, and also in looking for a pillar in the direction which the springer indicates, and at a suitable distance from I E. The direction is that of a line drawn from I E to X M, Fig. 6, but as these pillars are about 24 feet apart, and the character of the vault does not admit of an arch of anything like that width, we are led to infer an intermediate pillar midway between I E and X M. An arch spanned from I E to such a pillar would be in the line indicated, and its curvature would agree with that of the springer. We show such an arch in the diagram, Fig. 52, and note for our restored plan a pillar situated

where a line from I E to X M intersects one drawn from IX N to IX S, Fig. 6, dividing the latter in the proportion of one-third and two-thirds.

The rib from III E shown at Fig. 53 has been twisted in the same manner as that from I E, though the change of direction has been rather more gradually induced. By the same method as that



Fig. 53.
Springer of III E.

which has been followed with I E we determine the position of a second pillar in line with IX N and IX S, and with the other dividing the distance into three equal spaces, which of course are spanned by arches or vaulting ribs. Our plan of the eastern bay of the compartment now assumes the form shown in Fig. 54. AA are the two pillars whose position has been deduced from the original springers of I E and III E. The ribs rising from II E are the same as those of the existing plan, the springers of which show that no change has taken

place in their direction or curvature, and it is sufficiently obvious, if we accept the pillars AA as accurate, that the three ribs from II E must have been met by other ribs, *a b*, *a b*, and *c d*, *c d*, the former pair rising from IX N and IX S, and the latter from the restored pillars AA of the diagram. There is direct evidence for the five ribs which rise from the three eastern pillars, and at the

very least there is a strong presumption in favour of the six ribs which meet them at the crown of the vault in the fact that there is no other intelligible method of completing the vault. We are justified, therefore, in adding to our plan not only the pillars AA, but the ribs which spring from them, as well as those which rise from the pillars IX N and IX S.

We have now exhausted the unaltered springers of the compartment, and are dependent henceforth on the guidance of the renewed and altered springers of the north and south ranges of pillars. It has been seen that at the west end the compartment was to have been divided into three spans, the vaulting being carried by two pillars in the same position as the existing pillars I M and II M, but of less diameter. But at the east end we have seen that it was also to have been divided into three spans carried by two pillars in line with IX N and IX S. There is some temptation to conclude from this that the threefold division was intended to be continuous throughout the length of the compartment. For,

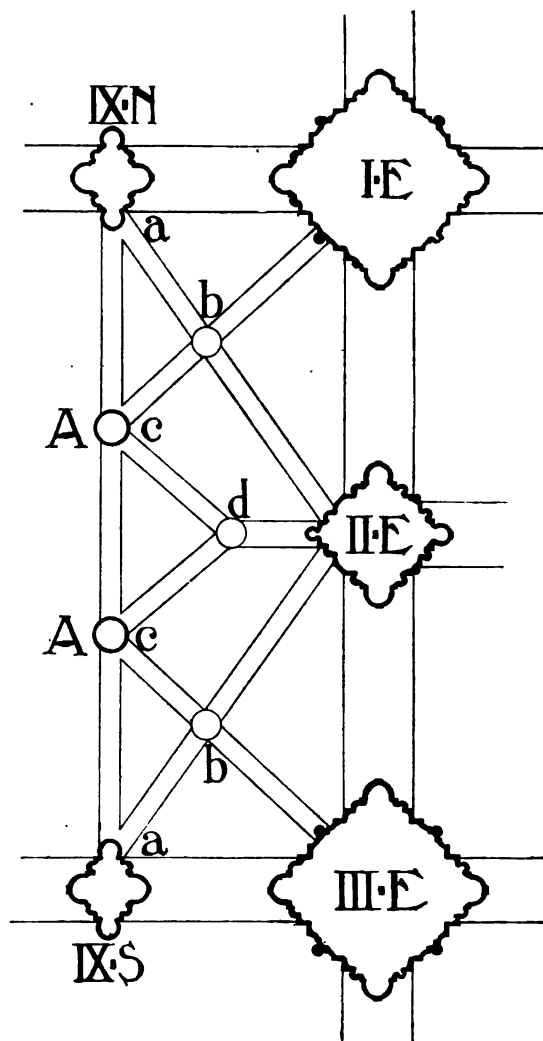


Fig. 54.

East End of Compartment.

if it were not so, why should the vault have been begun with this division at the west end, and why, starting from two arches at the east end, should it have changed immediately into three arches? Yielding to this idea in 1895 we came to the conclusion, after a short inspection of the vault, that the evidence pointed to the early plan having been founded, like so many others of the same period, upon three equal and parallel ranges of vaulting, and our conjectural plan of that date embodied this view. Further

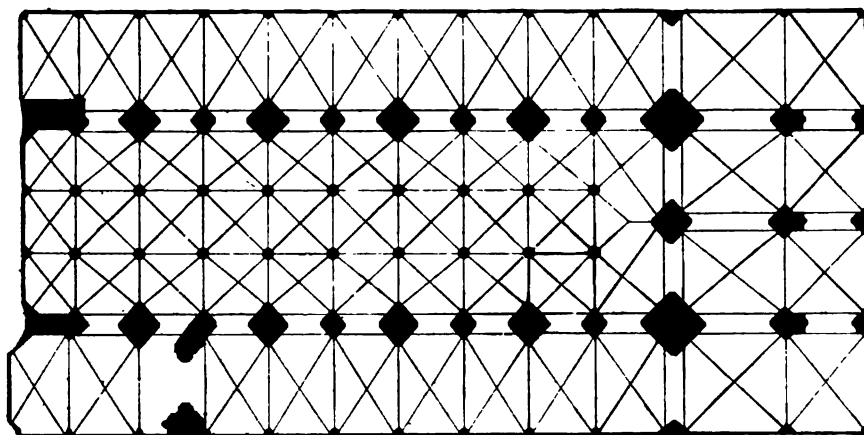


Fig. 55.
First Conjectural Plan.

consideration and a renewed examination of the vault have led to some modification of this idea, and the ensuing chapters are devoted to the explanation of our later views on the subject. We illustrate in Fig. 55 the conjectural plan of 1895, which may be regarded as the first essay towards the solution of a problem of some complexity. We may claim at least to have shown by this sketch in what the "pretty and instructive puzzle" of the middle vault consisted, and by what means its solution might be accomplished.

Chapter XI.

The Superseded Plan of the Middle Vault— Continued.

IN the preceding chapter we have examined the seven unaltered springers of 1240, and founded our conjectural plan at each end of the compartment on the direction which the ribs were originally designed to take as indicated by these springers. In the present chapter we deal chiefly with springers of 1240 that have been altered to adapt them to the later design of the middle vault. The next and concluding chapter is occupied for the most part with springers of 1260 that have been substituted for the original ones of the earlier date.

In many of the ribs which rise from altered springers the change of direction is not less conspicuous than we have seen it to be in a number of the unaltered springers. To avoid misconception, a few words may be permitted on the subject of twisted ribs.

The usual vaulting rib of the middle ages is simply one half of an arch, and as such its natural and normal course, as represented on a horizontal plan, is a straight line. A lateral change of direction, however—the deflection of the rib to one side or the other—is not an unusual incident—even its deflection first in one direction and then in the other is not unknown. Deflected ribs are of three kinds. There are those designed to be so,* those accidentally twisted or dislocated through unequal movement of the building, and those whose direction has been altered owing to a change of design after the springers were built. There is usually no difficulty in distinguishing between these three classes, and there should be no confusion regarding them.

* Either originally or at the reconstruction of a vault; the south-west compartment offers an illustration of the latter.

The twisted groin belongs of right to the Romanesque vault of a date anterior to the invention of the vaulting rib. The intersection of two cylindrical vaulting surfaces of different diameter produces an irregular and sometimes almost serpentine line at the angle or edge at which they meet ; this irregular and sinuous curve was reproduced in a modified form in many of the earliest rib vaults of the pointed style, partly, we may suppose, as a matter of preference or as a survival of the Romanesque groin, and partly to facilitate the disengagement of the ribs at the springing. When, however, the true function of the vaulting rib, that of an arch, was fully realised, and after the first difficulties of the springer had been overcome, the rib, like any other arch, was usually spanned from point to point, following a straight line on the plan. From this time, and until the number of vaulting ribs was increased by the introduction of the tierceron, the designedly twisted rib is exceptional in English vaulting ; where it occurs it is commonly due to some irregularity of the plan, as in the case of a circular aisle or chapel. On the development of the tierceron vault the twisted rib again came into occasional use for reasons which it would take too long to enter upon here. What we have to note is that at the respective dates of the aisles and of the middle vault at Glasgow the designedly twisted rib is of rare occurrence ; when it does occur its presence is to be accounted for by some peculiarity or irregularity of the plan.

The rib twisted by irregular settlement or other unequal movement of the building is common in the vaulting of every period, but it is rather a dislocation than a deflection, and even when it has been carefully repaired a rib of this class can hardly be mistaken for one of the others. Unfortunately, the dislocated ribs both of the upper and lower aisles of our Cathedral are numerous owing to the continuous outward movement of the side walls.

The third class of deflected ribs, those due to an alteration in the direction or curvature of the ribs after the springers were built, is, in the great majority of cases, quite as easily distinguishable as

the others. The fact that in this class the change of direction begins somewhat abruptly at the top of the springer, or that, where it starts from a lower point, the springer has obviously been altered, should be sufficient to prevent any confusion of such a rib with those designedly twisted, in which, of course, the change of direction is gradual, and extends over the greater part of the rib. In the case of the vaulting of the middle compartment the merest glance is sufficient to show that many of the ribs have been altered in direction since the springers were built. There is nothing in the design of the vault to account for the twisting of even one of these ribs—still less that of upwards of thirty; there is nothing that will allow us by any effort of imagination to suppose it to be due to the movement of the building; lastly, the peculiarity of a sudden change of direction immediately above the springer in so many of the ribs on the outer fringe of the middle vault is not found elsewhere in the Cathedral, either within the area of the middle compartment or beyond it. It is curious that of those who deny the change of plan no one has suggested an explanation of a phenomenon on any other hypothesis so remarkable as this.

It has been seen that at both ends of the compartment the springers are original and unaltered, and the mouldings wholly of the B class. Along the sides of the compartment, however, we have a great variety of moulding, the B, C, and D types being present in fairly equal proportions, and with some peculiarity of conjunction. There are, for example, springers of B mouldings alone; springers of B and D mouldings together; and others of B, C and D mouldings in combination. Besides these, we have ribs of the B C section irregularly dispersed among the other varieties. In place of the three or four rib mouldings that we should expect to find in such a vault, we have no fewer than nine different sections. It is significant also that, including the B C section with the B mouldings, not one of the twenty-five outer springers of the compartment is without a rib of the B variety, while in the springers of the

middle pillars they are almost wholly absent. For the variety of the mouldings in the outer springers and the irregularity of their dispersion our readers will expect some explanation. We must endeavour to distinguish the handiwork as well as the mouldings of different periods, and to account for the extraordinary variety of section to be found on each side of the compartment.

We have ascertained that when the north and south aisles were built, and the outer springers of the middle compartment originally formed, the B mouldings were the only ones employed in the vaulting ribs. The springers of 1240 were thus wholly of this type of moulding; any springer, therefore, that bears a C or D moulding is not original—at least it is not an unaltered original springer. It does not follow, of course, that every springer that has a B moulding, even every one that is composed wholly of B mouldings, is original. On the contrary, we shall find a number of springers of the later date with the earlier moulding; the reason for the presence of this moulding in the later work being obvious in some cases, and in others not beyond the power of ordinary intelligence to discover. We have seen, for example, that the pillars I M and II M, Fig. 6, with all the vaulting which they carry, are of the later date. But the springers and ribs on the west side of these pillars bear the early mouldings, the western bay or aisle being vaulted with ribs of the B section. Plainly this is due to the four original springers on the west wall which led the builders of 1260 to vault the bay throughout with the B 2 moulding. We have therefore the springers of the pillars I M and II M with D mouldings on the east, north, and south sides, but with B mouldings on the west. In the same manner, and for the same reason, we find the springers of I N and I S with B, C and D mouldings on their several ribs. The old springers here have been removed and new ones inserted in their places having the mouldings in current use at the time, the C and D moulds, wrought upon them; but as the western aisle, owing to the retention of

four original springers on its western side, was to be vaulted with the B₂ rib, this moulding is wrought also on the four new springer stones on the eastern side of the aisle. We have thus the obsolete B moulding used at the period of the middle vault, and along with the current C and D mouldings.

It will be perceived that the retention of a number of the old springers implied not only that the ribs which rise from these springers should be of the early moulding; it implied also that some of the other ribs with their springers, although wholly of the later date, should have the same moulding. We shall not therefore be surprised to find B mouldings wrought on some of the later springers along with mouldings of the C and D type, and the discovery that mouldings of different character may be found wrought together on the same stone will not lead us to infer that vaulting of different periods is altogether of one date, or that it belongs to one original design. Those who are able to distinguish the architecture and mouldings of one period from those of another will conclude that where earlier and later mouldings are wrought together the work is of the later date, and that where the obsolete B mouldings are found in the later work their presence may be accounted for by the proximity of vaulting or of vaulting springers of the earlier date.

Pursuing now our examination of the springers, we find four of the north, and the corresponding four of the south range of pillars that have only two ribs apiece, while the other springers of the series have each three ribs. As the springers of two ribs belong to the design of the two large squares of vaulting introduced in 1260, we conclude that in their present condition at least they could not have formed part of the early plan; they must therefore be late or altered springers. A glance will show that most of them are the latter—that originally they have been springers of three ribs, and that they have been turned into springers of two ribs by the simple process of cutting away the middle rib and leaving the others. That is a short and easy method of adaptation,

but it results in an obviously mutilated springer, with ribs separated from one another by a rude and misshapen wedge of stone. It destroys the vital relation between the shaft and the vaulting ribs, and leaves an awkward and useless shelf on the abacus or upper member of the capital—a defect studiously avoided in the original design of the vaulting of this period. It is open to the further objection that, unless the direction of the vaulting ribs happens to be identical in the late and early plans, some twisting or deflection above the springer is involved by the alteration.

At first sight all the springers of two ribs of the north and south ranges seem to have been, in their original condition, springers of three ribs like those of the aisles, and to have been turned into springers of two ribs by the process which we have described. In spite of their general resemblance, however, we must not assume that they are in every case of this character. It is perfectly evident that they are all abnormal springers, and it is equally clear that most of them are altered springers; but we are dealing with a substituted design that has been dovetailed into the middle of a partially executed plan, and the points of contact require separate examination. We shall therefore consider each of the eight springers with a view to deciding whether it is an original springer of 1240 or not, and of ascertaining at the same time whether it is such as to throw any light on the original design of the vault.

The eight springers of two ribs now to be examined are those of the pillars II N, II S, III N, III S, VI N, VI S, VII N and VII S of the plan Fig. 6, and they are shown by photographs and detail plans in Figs. 59 to 66 inclusive. The most prominent characteristic of the series is that the ribs do not enter into combination with one another, but are separated by a protruding mass of stone, on which the inner member of each rib dies out. In the normal vaulting of this period, when two or more ribs spring from a single vaulting shaft, the rib mouldings are always to some extent engaged in one another; where, therefore, there is

no intersection of the ribs, as in each of these cases, we may recognise an altered, or at least an abnormal, springer, and we may suspect a conjunction of different periods.

We are not without examples of the normal and unaltered two-rib springer of the period of the middle vault, and a comparison of one of these with the two-rib springers of the north and south ranges will spare us further insistence on a point which should be sufficiently obvious already. On the west side of the large western square of vaulting and on the east side of the eastern square, at I M and II M, and at IX M and X M, Fig. 6, there are two-rib springers of 1260, one of which we illustrate at Fig. 56. The difference between a three-rib springer altered into one of two ribs and a two-rib springer designed as such at the period of the middle vault is too apparent to require further demonstration.

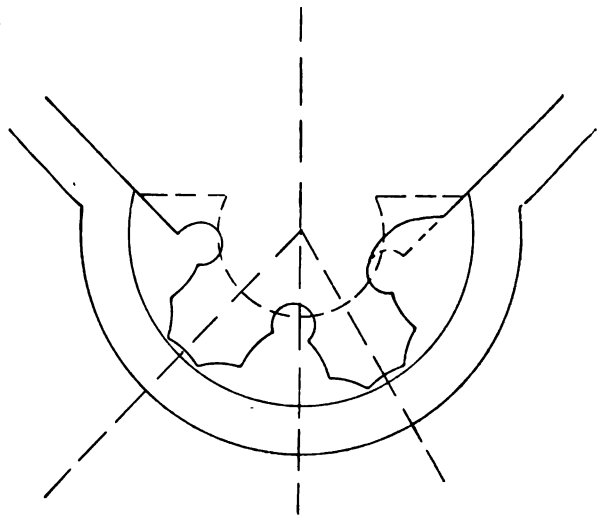


Fig. 56.
Springer of East Side of I M.

Another feature of the normal springer of the middle of the 13th century is that it overhangs the vaulting shaft pretty equally all round, in front as well as at the sides, and occupies nearly the whole upper surface of the capital, excluding of course the projection of the abacus beyond the line of the capital proper. (See fig. 26, page 63.) The beauty of the vault consists, indeed, in some measure in this fact, and in the perfect adjustment of the overhung springer to the vaulting shaft which supports it. But the eight springers of two ribs (figs. 59 to 66) do not fully occupy the capitals; instead of the mere projection of the abacus there is a vacant shelf from four to six inches in width, a defect never found in the unaltered work of this period.

It is equally evident that the majority of the eight springers were in their original condition springers of three ribs, of the same date and closely resembling the springers of the north and south aisles. For the purpose of comparison we give in Figs. 57 and 58 two of these unaltered springers; they are from the north side of the pillars II N and III N, Fig. 6, a major and minor pillar respectively, and they illustrate the different angles at which the ribs spring, as described in Chapter IV. and shown by the diagram Fig. 25, page 62. It will be noted that owing to this difference of angle the ribs of Fig. 57 are further apart on the springer than those of Fig. 58, and the mouldings, therefore, less involved in one another, the springers corresponding with the two diagrams of Fig. 26, page 63. The springer shown by Fig. 57 is exceptional in respect that, owing to the contraction in the width of the bays at the west end of the north aisle, two of the ribs fall a little within the bounding line of the springer on the abacus. The great majority of the springers of the aisles, however, have the front edge of their ribs just touching this line, as in Figs. 26 and 58.

As explained in Chapter IV., the variation of the springers of the aisles is due not only to the alternation of the larger and smaller pillars, but also to the irregularity in the setting out of the building,

and it is such that, while the range of variation is small, scarcely two of the springers are identical. In the case of the original springers of the middle vault, we may expect to find a somewhat wider range of variation than in those of the aisles. We have the same irregularity in the setting out of the building, and we have the same alternation in the size of the pillars of the main colonnade. But in addition we have a greater variety in the setting out of the pillars of the middle compartment than in the wall shafts of the aisles. We are speaking just now of the arrangement of the pillars of the original plan of 1240, and although we have not yet completed its restoration we have ascertained the existence on this plan of pillars corresponding with those at I M and II M, Fig. 6, though of less size than the existing pillars. We have found

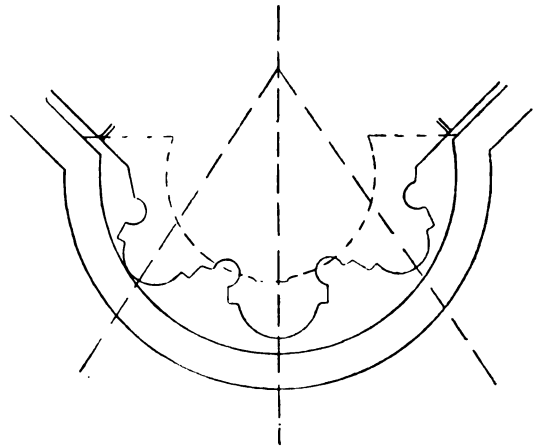


Fig. 57.

Springer of North Side of II N.

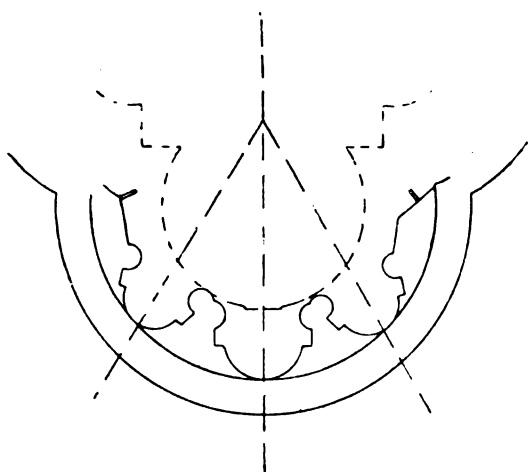


Fig. 58.
Springer of North Side of III N.

reason to believe also that at the east end of the compartment there were to have been other two pillars dividing the interval between IX N and IX S into three equal spaces. (*See* Figs. 48 and 54.) These four pillars of the restored plan determine the fact that the original springers of the middle vault, those at all events at each end of the main colonnade, while composed of the same mouldings, must have had a wider range of variation in their setting out than the springers of the north and south aisles.

Coming now to the springers of two ribs of the north and south ranges, and beginning with II N and II S, Figs. 59 and 60, it will be seen that these are of the period of the early plan, and have been originally springers of three ribs of the same character and composed of the same mouldings as those of the north and south

aisles. The ribs which remain are of the B2 section, and between each pair of ribs there has been a third rib, presumably of B1 section, which has been hewn off to adapt the springers to the later design of the vault. The rib on the west or left side of II N is considerably twisted above the springer, while the other rib of that springer and both ribs of II S are also twisted, though in a less degree. The angles at which the ribs have been set out are unequal, but obviously they have not been designed with reference to the existing vault. We pass over this point for the moment to return to it after the examination of the other springers of the series.

It is evident that all the springers of two ribs in the north and south ranges of pillars are abnormal, and in most cases have been formed out of three-rib springers of 1240. There are, however, two, those of III N and

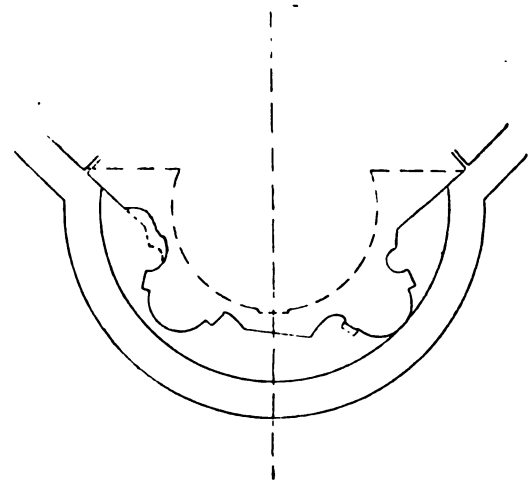


Fig. 59
Springer of II N.

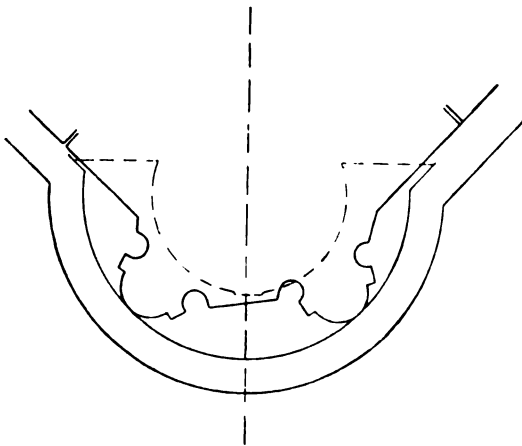


Fig. 60.
Springer of II S.

VI S, which are somewhat different from the others. They do not bear the same signs of alteration, and they are more finished and regular in workmanship than the other six. Instead of altered springers of 1240, we judge them to be springers of the period of the middle vault that have been formed in imitation of the converted springers of the earlier date with which they range. Although bearing a general resemblance to the other six springers, they do not appear to have been, like them, springers of three ribs that have been altered into their present condition. The ribs are again of the B2 section, but the intervening wedge of stone is apparently not such as would have been left by the removal of a B1 moulding; it is too wide and too regular, and, in the case of the III N springer, Fig. 61, is distinguished further by the absence of the circular

hollows that may be seen in the other examples. It would appear, therefore, that at III N, and as we shall see later at VI S, the builders have substituted new springers for the old ones, but, in order to maintain some effect of uniformity, they have made the new springers to resemble the altered ones. The ribs are set out to the angles required by the new plan, and we have accordingly no pronounced twisting above the springers; we have only such slight indecision as may be accounted for by the imitative method of their design. We do not profess to speak with absolute certainty, but it is obvious, we think, that if the springers are not altered ones of 1240 like the others, they have been constructed on the pattern of such; in either case they are quite unlike the normal springer of any period known to archæology.

In III S, Fig. 62, we

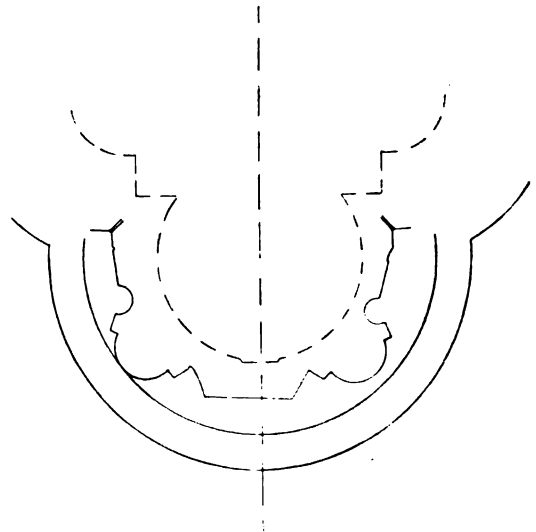


Fig. 61.
Springer of III N.

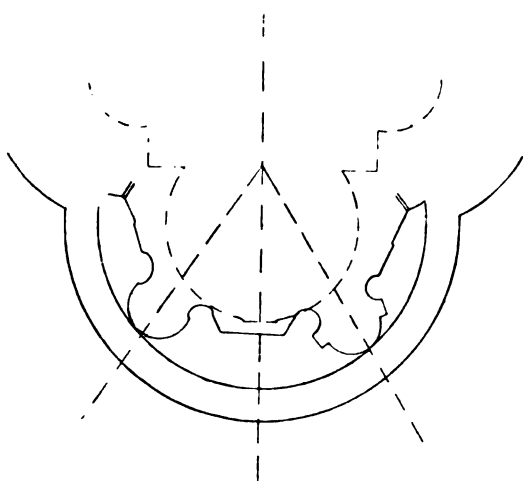


Fig. 62.
Springer of III S.

have another of the altered springers, and one with points of interest peculiar to itself. The middle rib has been removed, as in the case of II N and II S, but in place of leaving the others with their B₂ section, the builders have altered one of them into the moulding that we have called B C, Fig. 5. This change consists in removing the fillets on each side of the lower member of B₂, and in working a new fillet instead on the under side of the rib, with the object presumably of facilitating the poising of the stones of the upper part of the rib on their wooden centering. It is difficult at all events to attribute the change to any other motive, as the springer is in a position of such darkness that a refinement such as this fillet can hardly be seen. It will be noted that so far as the fillet was worked on the old stone—so far, that is, as it belongs to the springer

—its projection is very small, while from the top of the springer upwards, where, of course, the work is wholly of the later date, the fillet assumes its natural development of about quarter of an inch of projection.

The other or western rib of this springer remains of the original B2 moulding, and the B C moulding is not found elsewhere among the springers of two ribs, a fact which suggests that the experiment of the conversion of the moulding of the eastern rib of III S was made after most of the other springers of the series that we are dealing with had been altered, or that it was found to be of doubtful advantage. The B C mould is repeated, however, as we shall find, on three of the springers of three ribs in the vicinity of the shrine.

We have then at III S a springer of 1240, originally of three ribs, but altered about 1260 by cutting away the middle rib, presumably of B1 section, and altering the eastern

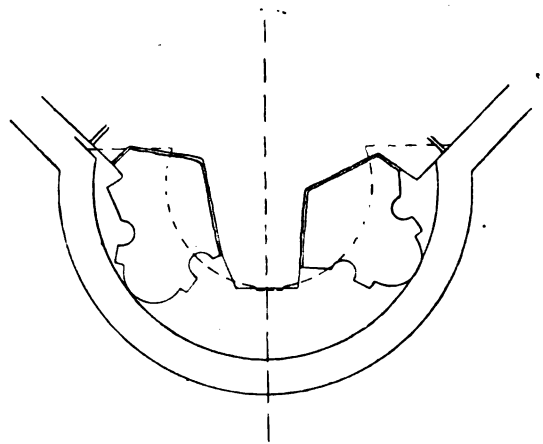


Fig. 63.
Springer of VI N.

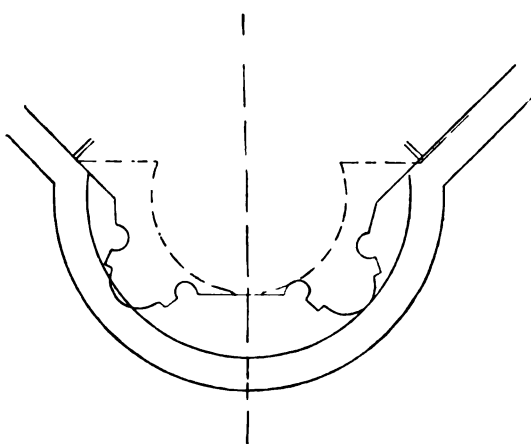


Fig. 64.
Springer of VI S.

rib from the B2 to the B C moulding. In the absence of any reason to the contrary we may assume the springer to be also in its original position, either to have been altered *in situ*, or, what is more probable, to have been taken down for the convenience of working, and afterwards replaced. It should accordingly offer some indication of the direction of the vaulting ribs on the plan of 1240.

We note first that the ribs have been set out forming the same angle with the centre line of the springer, or nearly so; they have not been set out to the angles required by the later plan. The original direction and curvature of the ribs on the springer point to there having been pillars on the early plan midway between II N and II S and between IV N and IV S, Fig. 6. These pillars would belong to a range down

the middle of the compartment, but how far this range may have

extended has yet to be considered. We do not affirm the existence of such a range of pillars on the evidence of a single springer, but we note the evidence as pointing in that direction. It will be seen from Fig. 62 that the eastern rib has been deflected a little towards the right from the level of the top of the springer, to bring it into the direction required by the present plan, and the western rib also has been slightly changed in direction.

The springer of VI N, Fig. 63, is again one of 1240 altered at the later date from a springer of three ribs to one of two, but the alteration has been of such a character as to leave slender traces of its original condition. The middle rib has been cut away as before, but the side ribs have also been cut out and replaced with ribs still of the B2 section, but in shorter stones, taken probably from the original springer of this or one of the other pillars.

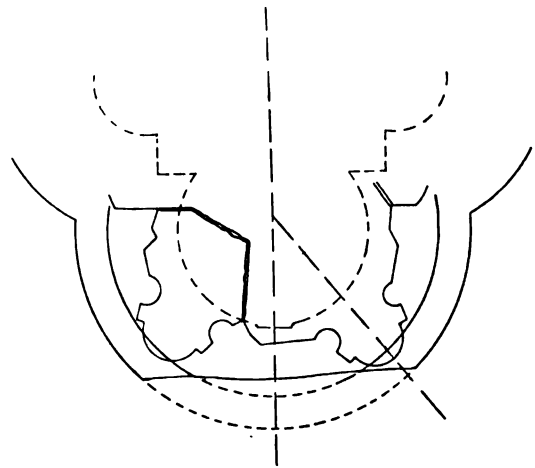


Fig. 65.
Springer of VII N.

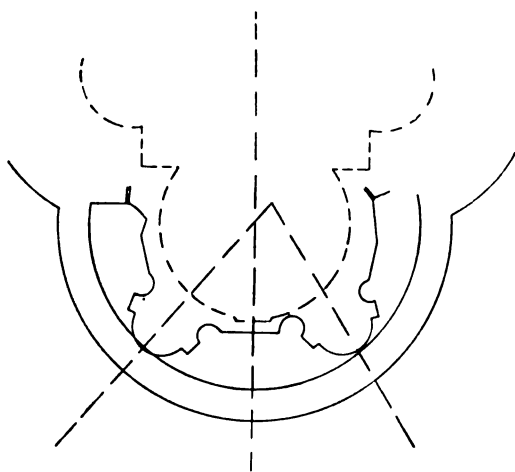


Fig. 66.
Springer of VII S.

As the ribs have obviously been adjusted to the direction that they were required to take in the later vaulting plan, they supply no positive evidence of the original angles of the ribs on the springer; we conclude, however, that there must have been a considerable change of direction in the ribs to have involved an alteration of such drastic character

The springer of VI S, shown at Fig. 64, is apparently a new one like that of III N. Its design is once more based on the altered springers, and is such as to differentiate it completely from any springer of normal character. It bears a general resemblance to that of III N, but the ribs are a little farther apart, the inner hollows are carried down to the capital, and the middle wedge of stone is farther back from the edge of the abacus.

VII N and VII S, Figs. 65 and 66, are altered

springers. The west rib of VII N has been cut out and reinserted or another put in its place, and the east ribs both of VII N and VII S have been altered in direction by the process of indenting a new piece in the upper part of the springer. In VII S the ribs are set out on the springer at different angles, the rib on the west side starting as if for a pillar midway between VI N and VI S, while the east rib points to a pillar in the position of the existing pillar X M, Fig 6. The east rib from VII N is approximately at the same angle as that from VII S; it may be accepted as pointing to a pillar at IX M, and as confirming the evidence of the springer of VII S.

The result of our examination of the eight springers of two ribs of the north and south ranges of pillars may be summed up as follows:—Six of them are apparently springers of 1240, originally of three ribs each, and altered in 1260 to adapt them to the later plan, while the remaining two are springers of 1260, whose design is based on the altered springers, to which it was necessary that they should conform. Excluding for a moment the altered springers of II N and II S, there remain four altered springers, III S, VI N, VII N and VII S; of these, VI N and one side of VII N have been altered in such a manner as to destroy or greatly impair the evidence of the original direction of their ribs; we infer from this fact, however, that their direction has been considerably altered. Two springers remain, III S and VII S, together with one side of VII N, to guide us in another step of our inquiry. Each of the springers III S and VII S is of two ribs, and where other clue is wanting they may be accepted as indicating at the same time the direction of the vaulting ribs of the pillars opposite them, as we may assume the plan to have been symmetrical; further, we may accept the middle ribs that have been hewn off the altered springers as transverse ribs springing at right angles to the axis of the choir, so that altogether we have a respectable number of vaulting ribs with which to continue our conjectural plan of the early vault.

In the preceding chapter we have found that the early plan included two pillars in the position now occupied by I M and II M, and two corresponding pillars in line with IX N and IX S, Fig. 6. In the present chapter it has appeared that the early plan must have had a third pair of pillars in the places occupied by IX M and X M, Fig. 6, and that three single pillars were placed on the axis of the building between II N and II S, IV N and IV S, and VI N and VI S respectively. We may assume intermediate pillars of the axial range between III N and III S, V N and V S,

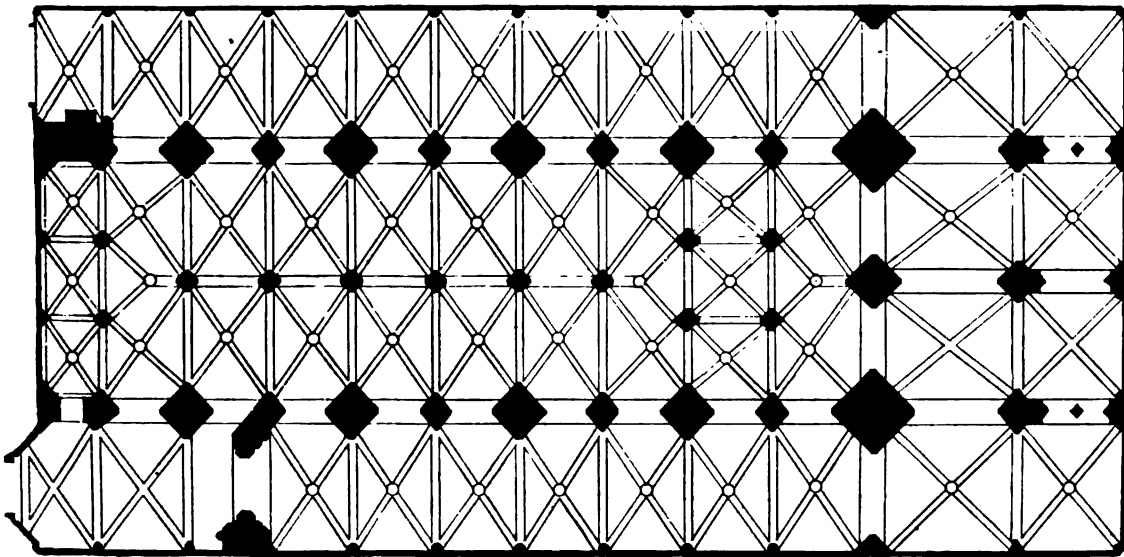


Fig. 67.

The Superseded Plan of the Middle Vault.

and VII N and VII S, and our conjectural restoration is complete, subject, however, to the examination of certain other points of some interest and not devoid of difficulty. Fig. 67 is a diagram of this plan as provisionally determined, and it will be recognised at once that the arrangement of the six axial pillars explains the existence of the unique arch moulding B 3, Fig. 5, which springs from the pillar II E, Fig. 6. A row of columns dividing the compartment for the greater part of its length into two equal

ranges of vaulting requires a series of main arches having a moulding somewhat heavier than that of the ordinary vaulting ribs. Such a moulding is found in B 3, and the mystery of a unique vaulting rib—unique no longer as regards the early plan—is explained.

In the next and concluding chapter we shall continue the examination of the pillars of the north and south ranges. Before leaving the springers of two ribs, however, it is necessary to return for a moment to those of II N and II S already referred to. We have described these springers as originally of 1240 and as having been altered in 1260. On each springer the east and west ribs are set off at different angles, but these angles are not those of the existing vault, nor are they the angles of the ribs on the conjectural plan. We have therefore to consider whether our provisional plan of the early vault can be modified in order to reconcile it with the springers of II N and II S, and if not, whether it is possible to account for the springers otherwise.

The particular pillars of the conjectural plan, Fig. 67, that seem to be inconsistent with the two springers are those in the position of I M and II M, and the one midway between III N and III S, Fig. 6. But the existence on the early plan of pillars at I M and II M is established by no less than four original and unaltered springers of 1240, those of the western wall. Whatever doubt there may be on any other point, we think the evidence in favour of the pillars at I M and II M will be regarded as conclusive. There is no direct evidence for a pillar midway between III N and III S, but we have such evidence in support of pillars midway between II N and II S and between IV N and IV S, and there is therefore a strong inference in favour of a pillar between III N and III S.

Setting aside for a moment the evidence of pillars at I M and II M and of the middle range of pillars of our conjectural plan, and assuming the springers of II N and II S to be not only original,

but also to be in their original places, we may ask what arrangement of pillars and vaulting would be indicated by them. On the west side the direction of the rib in each case seems to call for a pillar midway between I N and I S, and on the east for two pillars between III N and III S, dividing the interval into three equal spans. A single pillar between I N and I S would be consistent with the division of the whole compartment into two equal ranges of vaulting, while two pillars between III N and III S would be consistent with its division into three equal ranges, but they are scarcely reconcilable with one another. They are contradicted by the evidence of the four western springers and by that of the springer of III S, but in addition to this they appear to be self-contradictory. We do not see, therefore, how the springers in their present position can be reconciled with their surroundings. On the other hand, they are undoubtedly among the altered springers of 1240.

There is only one conclusion to be drawn if the facts are as we read them—that the springers, though original, are not in their original places. We must suppose that the builders of 1260, finding the original springers of II N and II S unsuitable in respect that the angles of the ribs were not those required by the new plan, removed them from the places which they occupied; that they considered at the same time whether among the other springers that had to be removed there were any that were more nearly adapted to their purpose, and that, having found such, they put them in the place of those removed from II N and II S. We are unable to suggest an alternative to this hypothesis, and we offer it, therefore, for the consideration of our readers. In support of some such change having been made, it may be pointed out that the springers do not fit into their places with the usual accuracy—the one on the south in particular being out of line with the straight portion of the pillar at each side of the vaulting shaft which carries the springer. On several grounds, therefore, we conclude that the two springer

stones in question are not in their original positions, but have belonged to other pillars than those which now carry them.

The evidence as to the direction of the ribs of the altered springers is of such a nature, and the difficulty of measurement is so great, that we do not pretend to affirm the accuracy of our observation at every point. On the whole, we think it amply sufficient to establish the general lines of our conjectural plan. It is hardly necessary to say that we shall welcome any emendation that may be made by the observation of others.



Chapter XII.

The Superseded Plan of the Middle Vault— concluded.

AMONG the features of the middle vault specially characteristic of the period in which its later and existing design originated are the two large squares with central pillars which have been compared to the vaulting of a Chapter House of the middle of the 13th century. These squares have three arches on each side; they have thus a pillar at each angle and two intermediate pillars on each side. We have examined the springer stones of the intermediate pillars on the north and south sides of each square, and it falls to us now to consider those of the eight pillars which occupy the angles of the two squares.

Each of these eight pillars has a springer of three ribs on the side next the middle compartment. The transverse rib in each case is of the D section, while the diagonal or oblique rib on one side, the arch that springs towards the central pillar of each square, is of the C section. The springers being obviously of the period of the middle vault, the ribs of C and D sections are, as we should expect, true in curvature and direction. The other diagonals of the springers, however—those outside the large squares of vaulting—are of the B 2 and B C sections, and most of them are twisted, some of them very much so. How are we to account for the early or converted types of moulding and the twisting of the ribs in work which is of the period of the middle vault?

But we have already accounted for the early moulding on two of these springers. At the pillars I N and I S the presence of the B 2 mouldings on the western diagonals has been explained by the existence of original springers on the west wall of the compartment.

These western springers of 1240 carry the moulding of their period, B 2 Fig 5, and on their account, and to save the trouble and inconvenience of altering them, the whole of this western bay of the compartment has been vaulted by the builders of 1260 with the B 2 moulding. We have accordingly the early moulding, not only on the four springers of 1240 on the western wall of the aisle, but also on the four opposite springers of 1260, I N, I M, II M and I S, Fig. 6. There is no difficulty, therefore, in accounting for the early mouldings in the springers of two of the eight angle pillars of the large squares, in I N and I S, and by their means a clue may be found to the explanation of the same peculiarity in the other six.

It will be observed that the eight springers in question are identical in design as they are in situation with reference to the large squares of vaulting; each of them is composed of three ribs of



Fig. 68.

Springer of IV N.

the B, C and D types respectively, reckoning the B C moulding as of the first class, and these three mouldings in each case are in the same relationship to one another and to the squares of vaulting. When it is added that all the C and D mouldings are true in direction, while the B and B C mouldings are in a number of cases twisted, it will be seen that the parallel is of the closest, and that

we are justified in reasoning by analogy from those in which the explanation is clear to those in which it is obscure.

In the examples that have been considered it has been seen that the presence of the early moulding is due to the existence of springers of the early date in the same severy of the vault—thus the moulding of 1240 on the springers of 1260, I N and I S, is explained by the



Fig. 69.
Springer of V N.

proximity of the springers of 1240 on the western wall, and the fact suggests a means of accounting for the same peculiarity in the other springers at the angles of the two large squares. The difficulty, however, is that in the case of some of the angle springers there are no opposite springers of 1240—there are none, that is, now in existence. But it is possible—there is even good reason to believe—that when these springers were wrought there may have been in existence springers and vaulting of 1240 that would account for the presence of the early

mouldings. We offer this, at all events, as a working hypothesis, and shall consider how far it is capable of explaining the facts as we find them. We note, further, that the analogy of the western springers is not the only indication of the former existence of early vaulting in the middle compartment; the springers and vaulting of the shrine and adjoining bays supply evidence to the same effect, which shall be noted as we proceed.

We take first the angle springers of the large squares found at the pillars IV N and V N and those of the corresponding pillars of the south range, IV S and V S, *see* Figs. 68 to 71 inclusive. The converging diagonals of the northern pair of pillars are of the B 2 and B C sections respectively, while those of the southern pair are both of the B C section, this moulding having been suggested apparently by the converted moulding of III S; all four diagonals are twisted, some of them very much so, the twisting or distortion starting, as in the other cases, at the upper bed of the springer. There is some variation in the degree of deflection shown by the diagonals, and this must be referred to the method and the particular order of their construction and to the difference in size of the pillars. Subject to this, it will be noted that the B 2 or B C diagonals are deflected towards one another, their initial direction having been towards a point of inter-



Fig. 70.
Springer of V S.

section more remote from the main colonnade than that at which they now meet. If it were possible to suppose the springers original ones of 1240, these ribs would support our conjectural plan with its axial pillars (*see* fig. 67) without further question; but, as the other ribs rising from the same springers carry the later mouldings, it is obvious that the springers are of the later date, and any explanation of their peculiarities must take this fact into account.

We have then rising from the four springers IV N, V N, IV S and V S, Fig. 6, two pairs of converging diagonal ribs, one of the four ribs having a moulding of 1240, while the other three have the B C moulding; in each pair these diagonal ribs are deflected towards one another above the springers (*see* figs. 68 to 71); the mouldings otherwise of the four springers are of 1260, and not



Fig. 71.

Springer of IV S.

twisted. Now, the distortion of a rib of each springer is unimpeachable evidence of a change of design at this part of the vault—it is evidence, moreover, of a change of design *after* the springers were formed. But the springers are not of 1240, but of 1260, the period at which the new plan was under construction. We have here accordingly a new discovery—we have in these four springers evidence of a change upon the substituted plan, a change which must have been made when the later design of the middle vault was in process of being

carried out. There is, in the first place, the plan of 1240 which we are trying to recover; there is again a plan of 1260, the existing vault; in addition to these we now find that there must have been an earlier and different version of the plan of 1260. Not only so, but the existence of B 2 and B C mouldings on the four springers of 1260 now under consideration, argues the existence at

that date of a portion of the vault of 1240 which it was intended at first to have preserved, but which was ultimately removed.

The point is one of some nicety, but we do not see how the conclusion is to be resisted or by what other means the facts are to be accounted for. We proceed then to consider by what particular steps the vault may have reached its present condition. The matter perhaps does not permit of absolute demonstration, and we do not claim to be able to prove conclusively by what means the present state of the vault at this point has been produced. It will

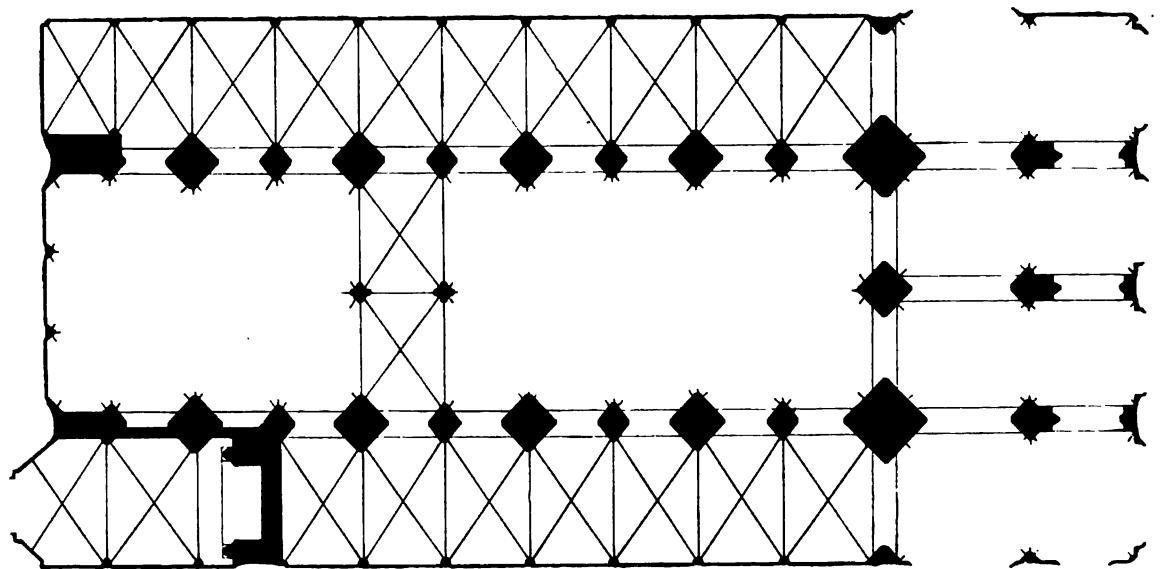


Fig. 72.

Diagram of Vaulting from 1240 to 1260.

be something, however, if we can show one method by which it may have been reached—a method which explains the existing peculiarities of the vault, which indicates with some probability, and we imagine with some approach to accuracy, the stages actually followed in their production.

We will suppose one bay of the middle vault—that between the pillars IV and V, N and S,—to have been constructed at the period of the north and south aisles, and, of course, in

accordance with the original plan of 1240. The condition of the vault during twenty years would then have been as shown on the diagram, Fig. 72. The construction of this bay of the vault at the early date may have been due to a desire to protect the site of the altar and tomb of Saint Kentigern, a spot that had been held in veneration during many centuries, or it may have been suggested by the practical purpose of staying the north and south ranges of pillars and the vaulting of the aisles against lateral movement; it would at the same time provide a means of direct communication between the north and south aisles of the choir, and a point of vantage from which the whole operations of the choir could be conveniently surveyed and directed. On the other hand, the construction of this part of the vault would involve no interference with the process of construction of the building, as, allowing for the supports to the centering of the ribs, the two openings for the passage of materials would still be as wide as those of the pillars of the eastern gable by which the roadway into the middle compartment was carried. There was therefore no practical difficulty and there would be some advantage in the construction of this part of the work along with the aisle vaulting, a course prompted, as we may suppose, by consideration for a spot consecrated by generations of worshippers, and over which successive churches had been reared.

When the builders of 1260 resumed the vaulting of the lower church, and the new plan of the middle area was evolved, we may assume hypothetically that the first idea of the designer may have been to incorporate the then existing work between the pillars IV and V, N and S, with his revised design of the vault, either to preserve it as it was, subject to the necessary alteration, or to take it down and reconstruct it on the same plan. Fig. 73 shows the three stages of the plan as we now assume them to have been; at X we have the original plan of 1240, of which one bay was carried out between the pillars IV and V (*see* fig. 72); at Y we

have the earlier of the plans of 1260, in which this bay was incorporated, and at Z the plan finally adopted. On this hypothesis

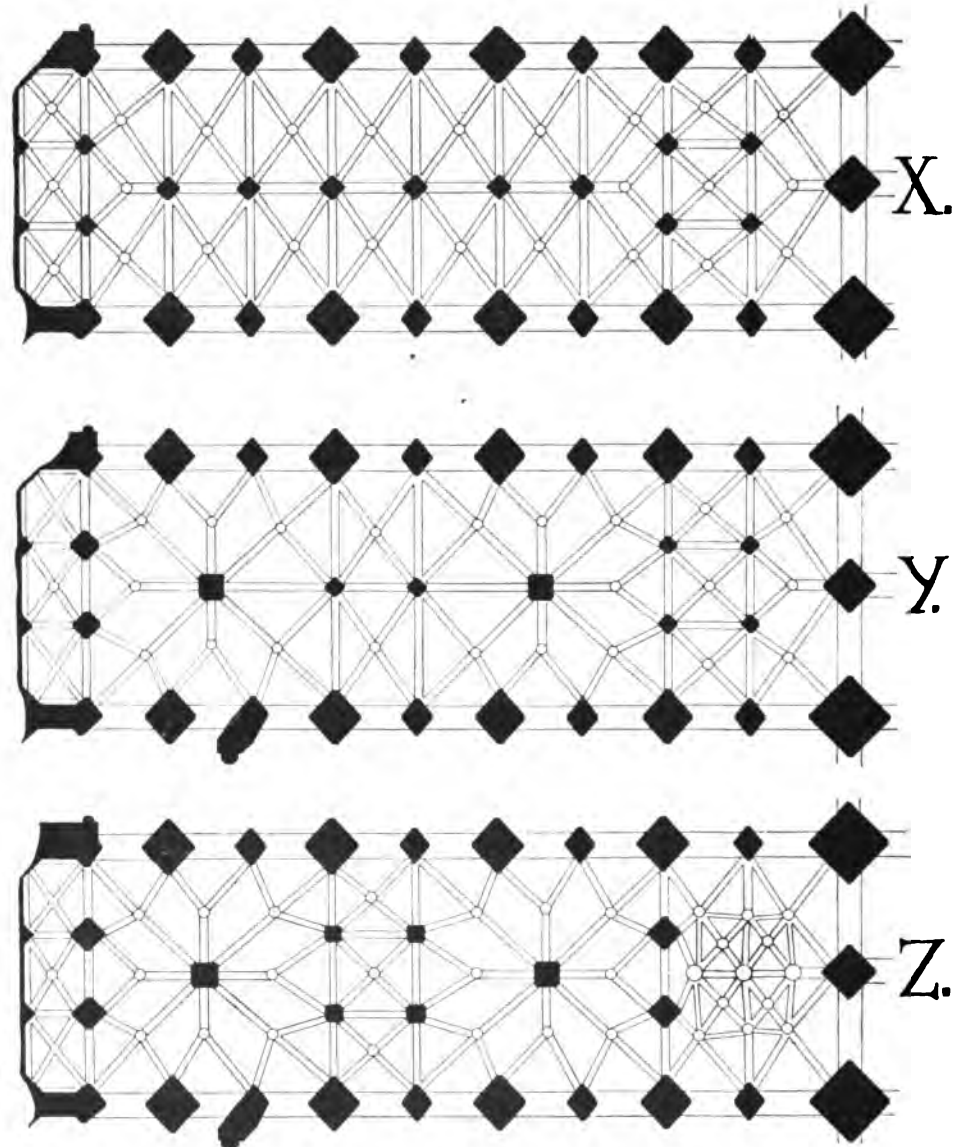


Fig. 73.
Three Stages of Plan.

the existing springers of the pillars IV and V, N and S, were wrought when the plan Y was in contemplation. Hence we have

the B2 and B C mouldings of the converging diagonals from these pillars, and hence also we have the initial direction of these diagonals towards the axial pillars of the early plan. On the other ribs, of course, the later mouldings were wrought, and in their case no change of direction was involved in the change from the earlier to the later phase of the plan of 1260.

There is another circumstance which points to a change of plan having been given effect to at this place while the middle vault was being carried out. The jointing of the springers of the four pillars of the shrine, IV M, V M, VI M, and VII M Fig. 6, is not normal. The springers of the three ribs which rise in the cardinal directions from each of these pillars are in separate stones from the four diagonal or oblique ribs. There is not very much in this fact to indicate the particular nature of the change, but it confirms the view that the four pillars were not originally contemplated in the revised plan—that they were imported into the design of 1260 only after some progress had been made in carrying out the work. The evidence, whether of the pillars of the shrine or of those of the north and south ranges, places it beyond doubt that a change of plan was effected at this point while the work was being carried out; whether this change was exactly that which we have described, or some variation upon it, we do not pretend to say; it is sufficient for our purpose to have shown one means of accounting for the existing condition of the vault; the subject is eminently one for consideration and discussion, and we offer it to archæologists with that end in view.

Passing to the eastern part of the middle vault, we find at VIII and IX, N and S, the last four of the outer springers, and here again we have the mouldings of 1240 and 1260 mingled in work of the later date, the early mouldings being due in all probability to the influence of the original springers of the eastern pillars, perhaps also in the case of VIII N and VIII S to the precedent of the other six angle springers of the two large squares. In VIII N and VIII

S, Figs. 74 and 75, we find, as before, the B, C and D mouldings in combination, while in IX N and IX S, Figs. 76 and 77, we have a transverse rib of D section between diagonals of the B 2 moulding. In our second plan of Fig. 73 we show the eastern bays still following the early design. There is nothing to fix the moment at which the change of plan was made in these two bays, whether at the commencement of the work of 1260 or towards its conclusion. The probability is, however, that the development of the plan at the east end would be coincident with that at the middle of the compartment, while in the alteration of the eastern rib of VIII S, Fig. 75, there is a distinct suggestion that this springer was designed with reference to the plan Y, Fig. 73. Considerations of light would naturally make the eastern section the last part of the middle vault to be constructed, and we note that in the final plan its design is a slightly later phase of the Chapter House type of vault than that of the square figures—it is of the type that dispenses with the central pillar. The springers of VIII N and VIII S must have been reconstructed in connection with the large squares, while those of IX N and IX S, naturally, would be the last of the outer springers to be treated. At IX S, Fig. 77, there is some little irregularity of the ribs both within the



Fig. 74.
Springer of VIII N.

limits of the springer and above it. The D moulding of the transverse rib is a sufficient guide to the date of the springer, but the irregularity of the diagonals of B moulding is a further indication that the springer is not an original or normal one.

In the whole eastern oblong section of the middle compartment



Fig. 75.
Springer of VIII S.

there are seventeen ribs springing from the capitals of vaulting shafts, and of these no fewer than thirteen are of the B type of moulding. But of these thirteen ribs, only five rise from original springers of 1240—those, namely, of the three eastern pillars. In the other eight ribs the early moulding is attributable to the retention of the original springers on the eastern pillars or in other parts of the middle vault. In the remaining part of the middle compartment the proportion is different, and a majority of the ribs which carry the early moulding

rise from original springers of 1240.

To sum up our examination of the twenty-five outer springers of the middle compartment, we conclude that seven are original and unaltered springers of 1240, six are original springers of that date that have been altered at the period of the middle vault, while the remaining twelve are new springers of 1260. The seven

unaltered springers occupy both ends of the compartment; the six altered ones are found among the eight two-rib springers of the north and south ranges; and the twelve new springers of 1260 consist of the other two springers of two ribs, the eight angle springers of the two large squares and those of the pillars IX N and IX S. On the thirteen original springers of 1240 we find none but B mouldings, including the converted B C mould of III S. The majority of the ribs which rise from original springers have been changed in direction to adapt them to the later plan of the middle vault, and the original direction of these ribs, where it can be traced, points to an early vaulting plan like that shown on Fig. 67, a diagram founded mainly on the evidence supplied by these thirteen original springers.

The six altered springers of 1240, now springers of two ribs, were originally springers of three ribs, and, like those of the north and south aisles, were composed of a transverse rib of B 1, and diagonals of B 2, section. They have been converted into springers of two ribs by the process of hewing off the transverse rib in each case and leaving the diagonals. The springers of III N and VI S have been formed in imitation of the six altered springers. The remaining ten springers of the later date are springers of



Fig. 76.

Springer of IX N.

three ribs each. Of the thirty ribs which they comprise, nine are of the B₁ or B₂, and three of the B C, section while of the others eight are of the C₂, and the remaining ten of the D₁ and D₂ sections. If we classify the B C moulding with the B ribs, we have in these springers twelve of the earlier and eighteen of the later type, while if we number it among the C ribs, we have nine

of the earlier and twenty-one of the later class of mouldings.

The presence of the early mouldings in some of the later springers is due to the proximity of early work to which it was necessary or desirable that the later work should conform. In the case of the bay which contains the shrine of four pillars the early work has disappeared, but we are able to infer its existence in 1260, with some confidence, from the indications that remain, and we find indisputable proof of a change of plan having taken place at this point while the



Fig. 77.

Springer of IX. S.

present design of the vault was in process of being carried out. It remains only to note that the ribs which rise from the later springers are generally true in direction, except where the final development of the plan of 1260 took place.

Our vaulting plan of 1240, Fig. 67, shows the compartment with a range of pillars down the middle for the greater part of its length.

At the second bay from the east end it is divided into three spans in the width, with four pillars forming a canopy like that of the shrine in the existing vault. At the west end the double aisle again changes into a three-fold division such as we now find it. Between the triple division of the east and west ends we have a range of six pillars which divide the area into two aisles of nearly the same width as the north and south aisles. The five longitudinal arches down the middle of the compartment, and the half arches at each end of the range, required a heavier moulding than B₁ or B₂, and this is found in B₃, Fig. 5, the moulding of the rib which springs from the middle pillar of the east end of the compartment, in line with the arches and half arches in question. It has been explained that this moulding occurs only once in the Cathedral. It is opposed to the practice of the middle ages to have a separate moulding for a single rib in a scheme of vaulting embracing several hundreds of ribs, and we doubt if a single instance could be found in which this occurs. The fact, therefore, of the moulding B₃ being found at present in one rib only is enough in itself to indicate a change of plan, though, unlike the other evidence to the same effect, the point might easily be overlooked. But it suggests more than the fact of a change of plan—it actually points to the range of pillars and arches down the middle of the compartment. If it has not led us directly to infer the existence of this feature in the early plan, it certainly goes some way in confirmation of a conclusion drawn from evidence of another nature.

We may be asked what reason, apart from the development of vaulting between 1240 and 1260, may have led to the change of plan. We are here to some extent in the region of speculation, but the point may be worthy of consideration nevertheless. It will be noted that our plan of 1240 (fig. 67), by the arrangement of its pillars and vaulting, confers architectural distinction upon one point only of the interior, the part beneath the high altar, and thus, naturally, the place of most importance in the lower church. The

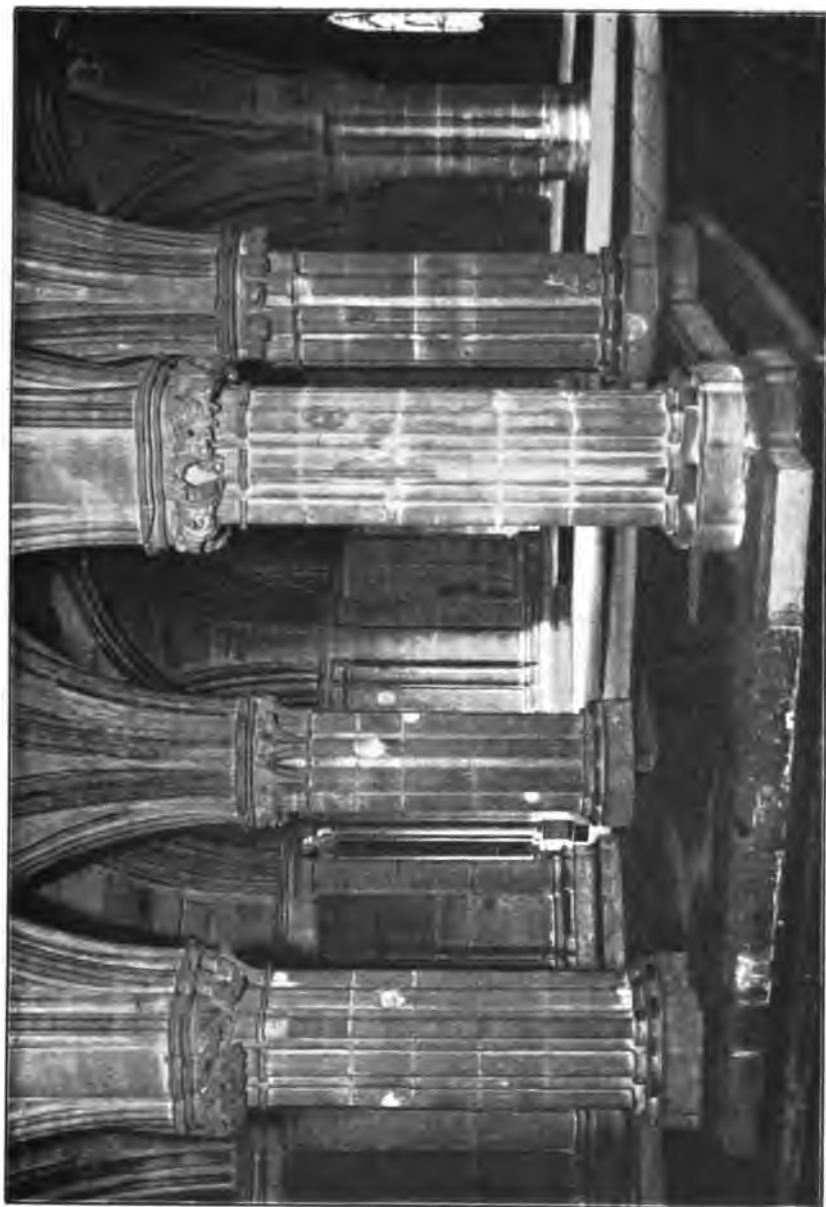


Fig. 78.
View of Shrine.

plan as we now find it, gives importance to two places, the space under the high altar and the shrine between the pillars IV and V, N and S. It is probable that the church of Achaius may have been designed with its high altar directly over the tomb of the saint, but in the church of Jocelin, with its presumably extended choir, the altar would naturally occupy a position further to the east. It may have been the first intention of Bishop Bondington to transfer the shrine in his new building to the place of honour beneath the high altar, where we find the canopy of the four pillars in our plan of 1240. When the final disposition was made, about 1260, the development of the art of vaulting had conferred new powers on the designer. In another respect also a great change had taken place. A little before the middle of the 13th century we find the number of the altars in our cathedrals rapidly increasing, and, in particular, we find more importance attaching to the services at the altar of the Virgin. It was the period of the great development of the Lady Chapel in the history of the English cathedral, and of the multiplication of altars to an increasing calendar of saints. When the final stage of the middle vault of our Cathedral was reached, and while the work was still in progress, we may suppose that a place of some distinction was desired for the chief altar of the lower church, an altar that was to be dedicated to the Virgin Mary. The site did not admit of a Lady Chapel in the usual position to the east of the choir, while the area of the lower church afforded ample space for this purpose. It may be suggested, therefore, that the eastern section of the middle compartment, beneath the high altar, was designed at this time as the Lady Chapel of the cathedral, and that the altar of the Virgin found its place in front of the pillar in the middle of the eastern gable of the choir.* At the same

* An altar to the Virgin in the lower church is repeatedly referred to in documents from the close of the 13th to the beginning of the 16th centuries, but the position of this altar has not been determined. As the four chapels of the east end were occupied by altars to (1) St. Nicholas, (2) SS. Peter and Paul, (3) St. Andrew, and (4) St. John, Evangelist, while the altar at the shrine was dedicated to the patron saint and his mother, there would seem to be no

time it would be decided that the shrine of Saint Kentigern should retain its historic position, and that, accordingly, this part of the plan should have additional dignity conferred upon it by transferring the canopy of four pillars from the east end to the middle of the compartment.

We see, at all events, that our plan of 1240 (fig. 67) has the feature of the canopy at the east end instead of in the middle of the area as at present. By forming an open space in the later plan, instead of the canopy, at the east end of the compartment, a chapel was provided for the chief altar of the lower church, while by transferring the canopy to the middle of the compartment another position of honour was secured, and the altar tomb of Saint Kentigern received the architectural treatment which its importance demanded. We find, then, in the final plan a more convenient, as well as a more beautiful, arrangement of the pillars and vaulting than that shown on the plan of 1240. But in 1240 this arrangement was not possible. The art of vaulting had not yet reached the stage at which the two large squares with central pillars could have been produced; still less had it reached the stage at which the oblong domical vault beneath the high altar could have been designed. In the earlier, as in the later, plan the full resources of the art at the particular moment were called into requisition; the difference between the two plans marks the development of vaulting between their respective dates, and it records the progress made between the separate periods of their inception.

There has been no attempt on the part of the builders of 1260 to disguise the change of plan. They have, on the contrary, proclaimed the fact at every point, alike in the design of the vault and the method of its execution. It may, however, be said that, from the artistic point of view, the middle vault has been finely

other place than that which we have suggested where a Lady Chapel could have been formed or where an altar to the Virgin Mary was at all likely to have been placed. See the chapter on "The Ancient Altars of the Cathedral," by Archbishop Eyre, in "The Book of Glasgow Cathedral," and "Scoti-Monasticon, the Ancient Church of Scotland," by the Rev. Mackenzie E. C. Walcott, London, 1874.

harmonised with the vaulting of the aisles, so that, apart from the contiguity of the work of two different periods of architecture, there is nothing essentially incongruous between them. There is a striking contrast, it is true, between the formality and regularity of the aisles and the play of fancy which the designer has allowed himself in the middle vault. But the work has been harmonised as well as contrasted. There is every probability that we owe both parts of the vaulting to the same mind; but it may be, on the other hand, that we have here the traditional apprentice who excelled his master, or it is possible that a new architect may have been imported. All that we can affirm is the interval of about twenty years between the design of the aisles and that of the middle vault, the second and fourth stages of our vaulting series. It is a fine compliment to the work of 1260 to be informed, as we have been by an architect of position and long experience, that "the whole design" (of the lower church) "was carefully thought out and settled before a stone was laid. It is a skilful and homogeneous design."* The lower church is in fact "a skilful and homogeneous design" in the artistic sense, but it is a design which bears the characteristic stamp of different architectural periods as plainly as any building in the world.

* "The Book of Glasgow Cathedral," p. 274.



LIST OF THE BISHOPS OF GLASGOW DURING THE 12TH AND 13TH
CENTURIES.*

John Achaius, 1115-1147.

Herbert, 1147-1164.

Ingram or Ingelram, 1164-1174.

Jocelin, 1175-1199.

Hugh or Hugo de Roxburgh, 1199.

William Malvoisin, 1200-1202.

Florence, 1202-1207.

Walter, 1208-1232

William de Bondington, 1233-1258.

Nicholas de Moffet, not consecrated.

John de Cheam or Cheyam, 1260-1268.

Nicholas de Moffet, 1268-1270, again elected but not consecrated.

William Wishart, 1270.

Robert Wishart, 1272-1316.

* "Registrum Episcopatus Glasguensis."

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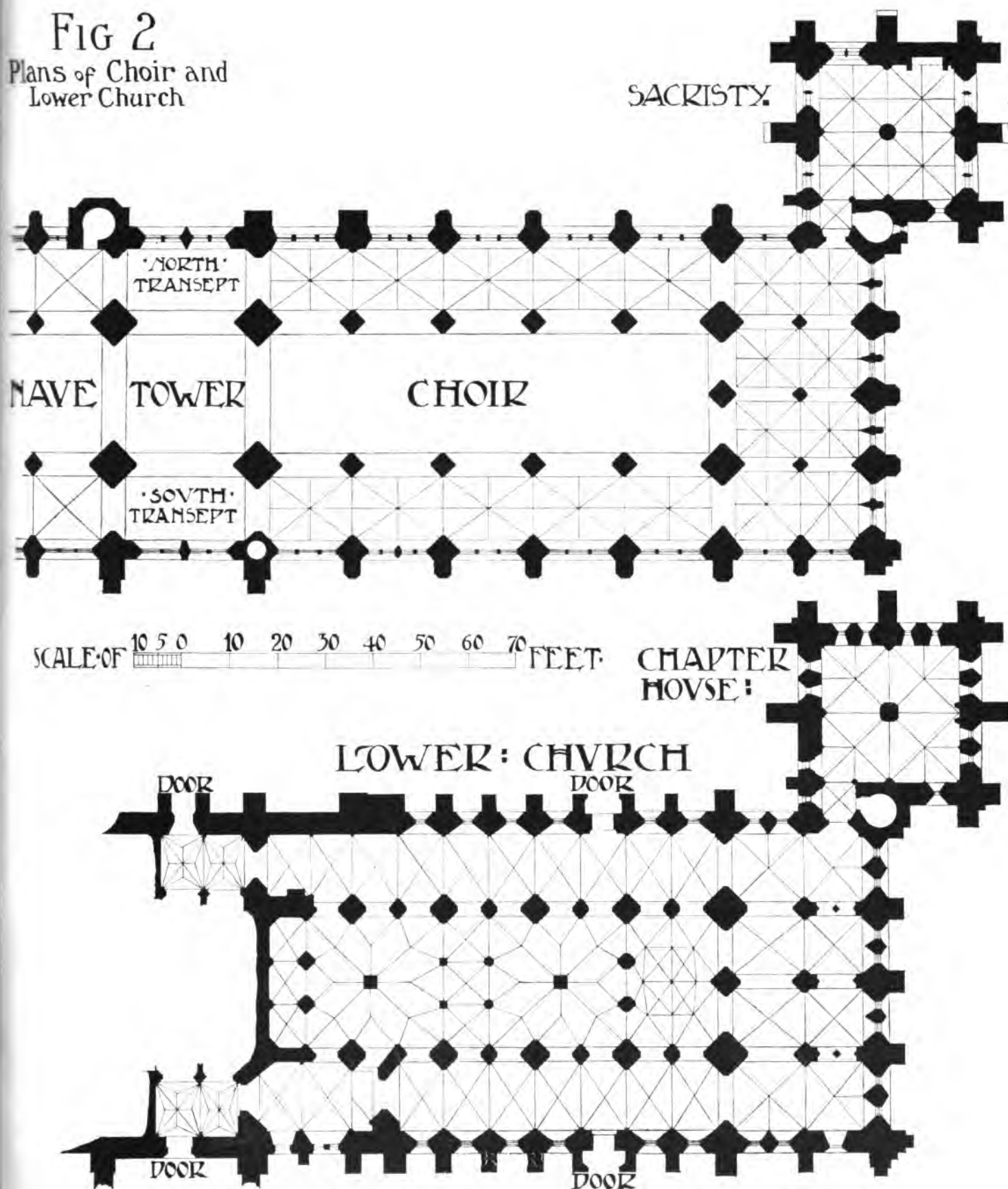
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FIG 2
Plans of Choir and
Lower Church



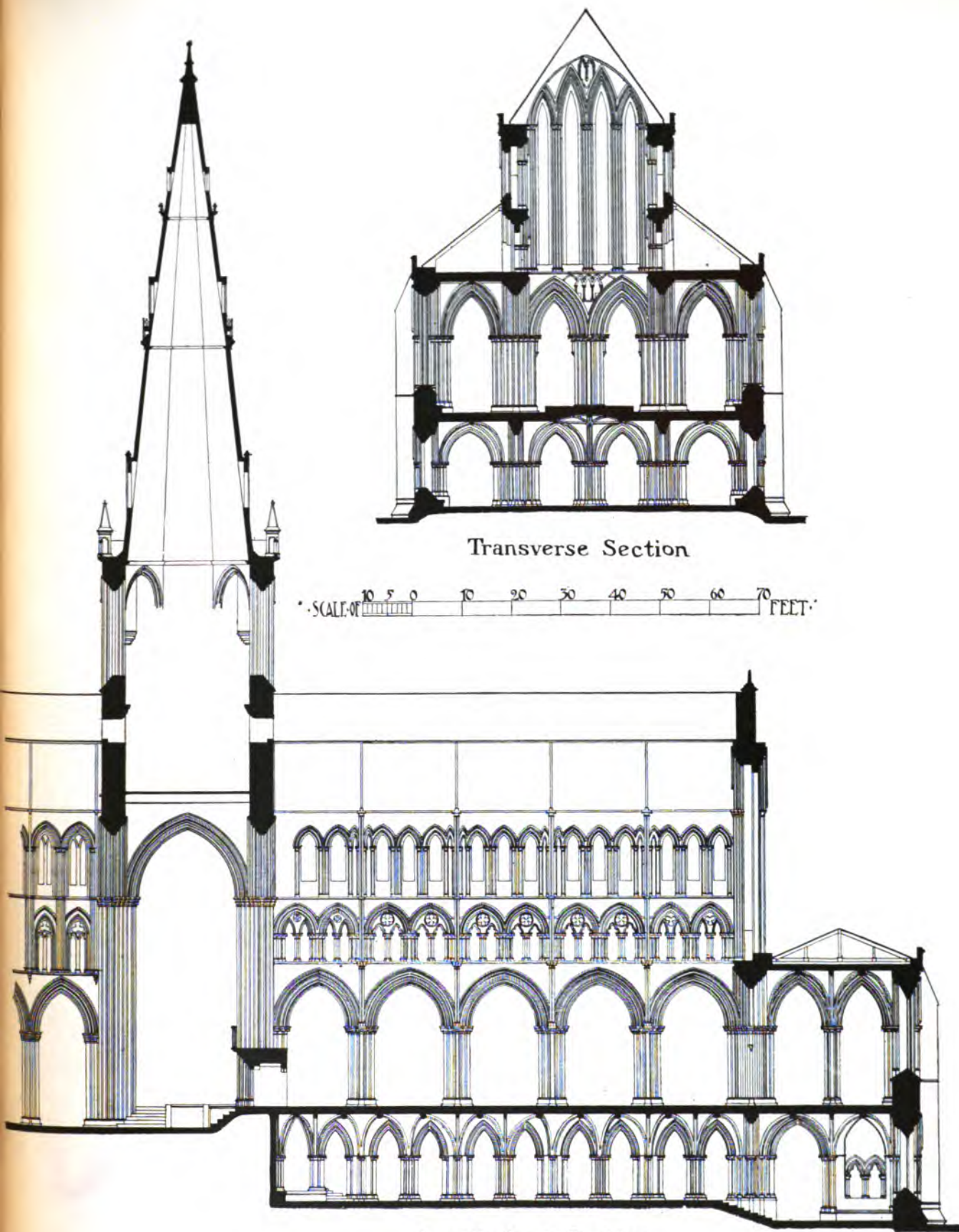
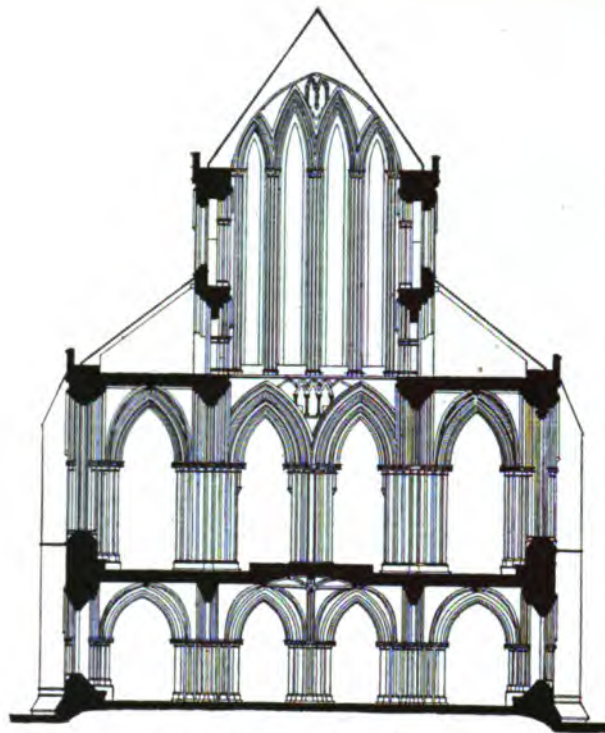
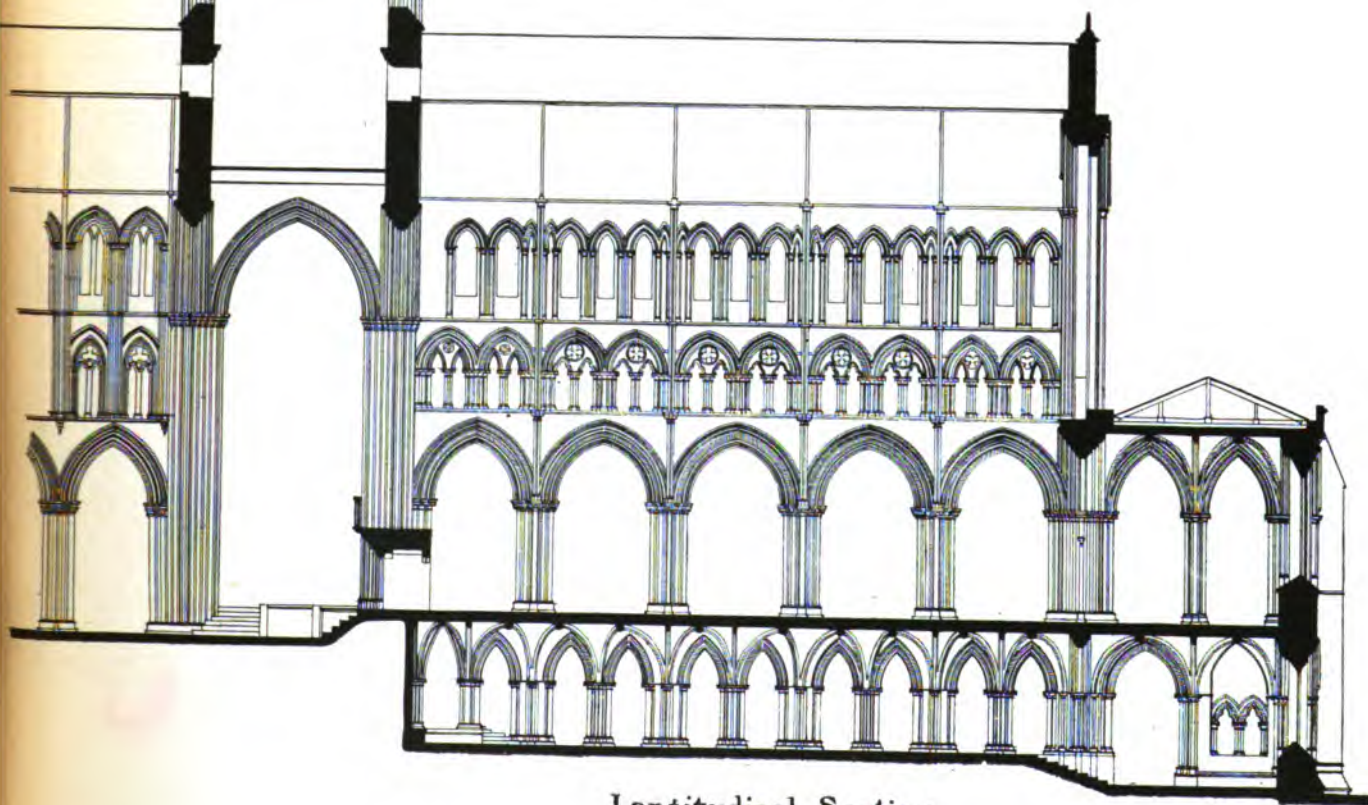


FIG 3
Sections of Choir



Transverse Section

SCALE OF 10 5 0 10 20 30 40 50 60 70 FEET

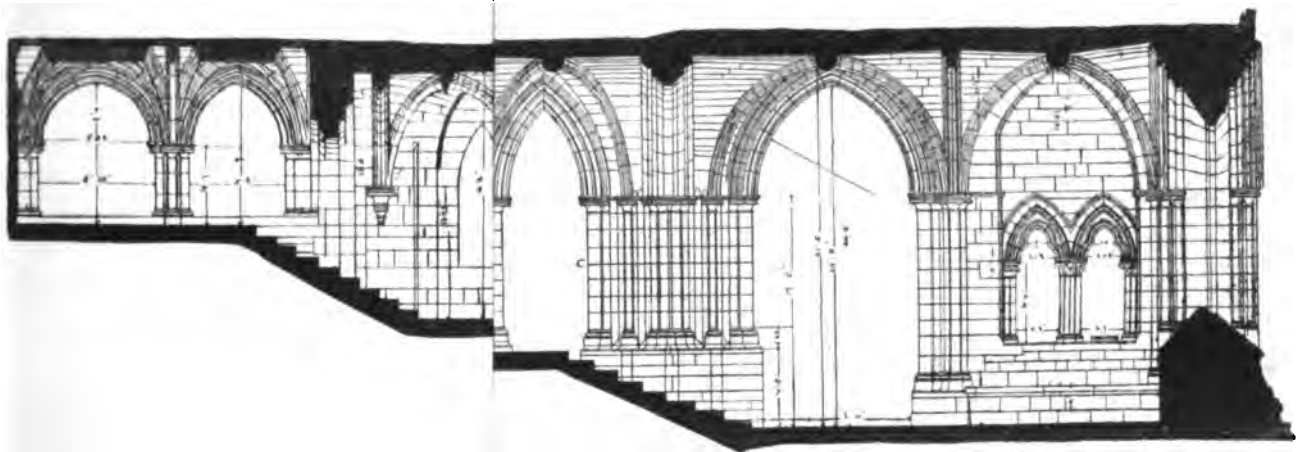
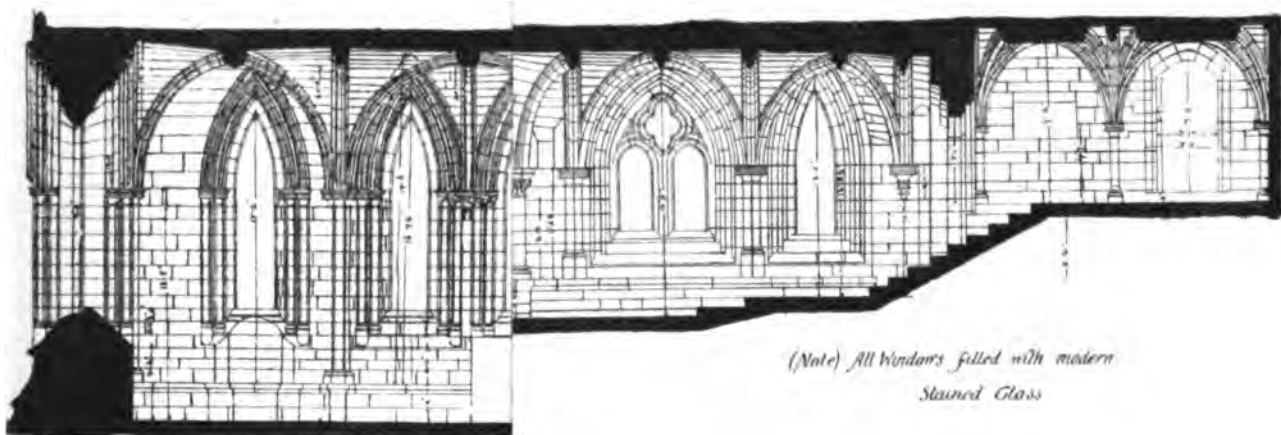


Longitudinal Section

FIG 3
Sections of Choir

GLASGOW CATHURCH.

Measured & drawn by Geo. S. Hill

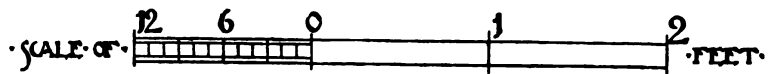
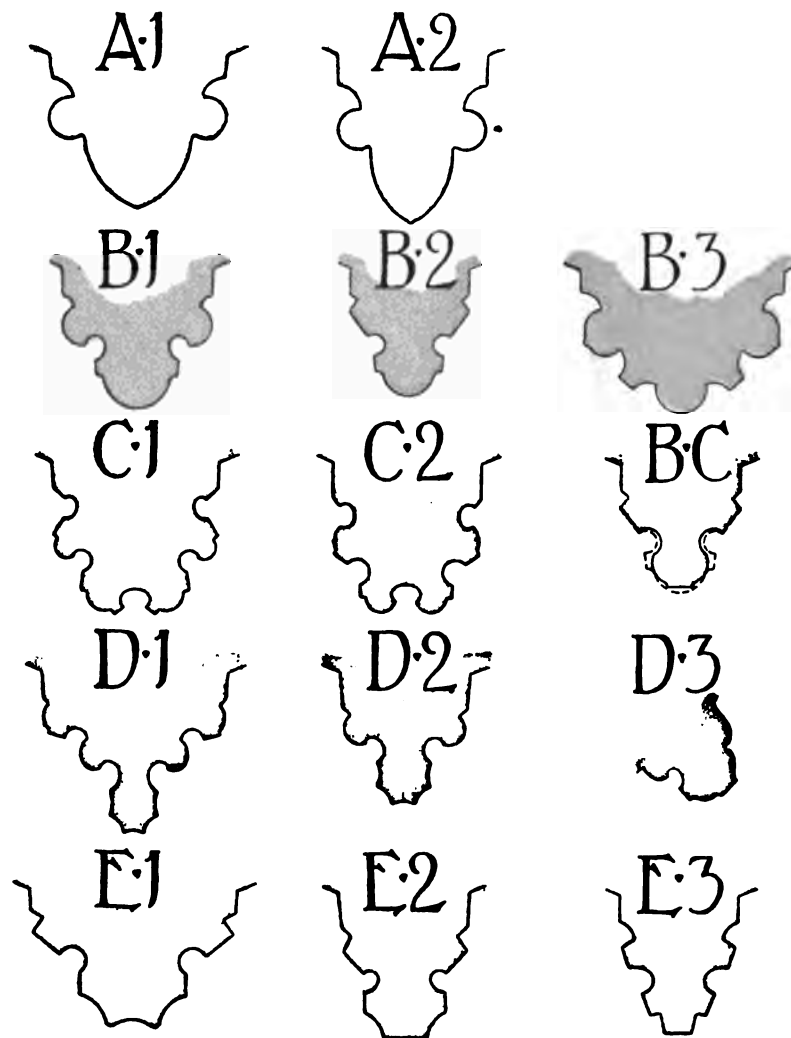


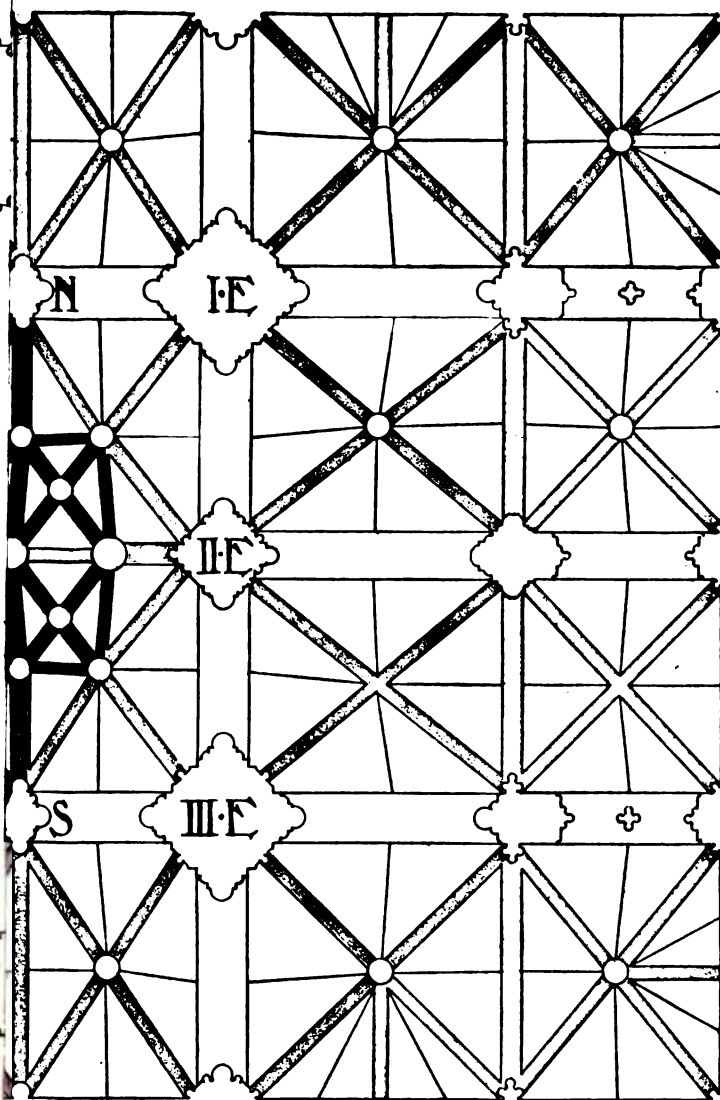
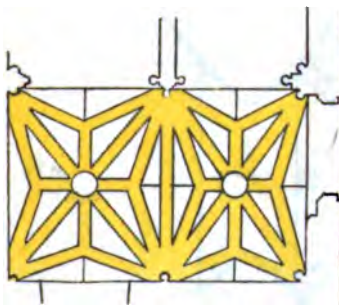
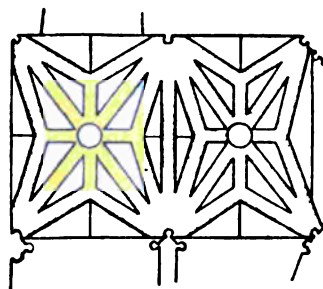
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FIG. 5-MOULDINGS OF THE VAULTING RIBS.





50 60 FEET

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